



The External Quality Assurance System of the WHO Global Foodborne Infections Network, 2014

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The External Quality Assurance System of the WHO Global Foodborne Infections Network, 2014



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CENTERS FOR DISEASE
CONTROL AND PREVENTION

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Institut Pasteur



DTU Food
National Food Institute

THE EXTERNAL QUALITY ASSURANCE SYSTEM OF THE WHO GLOBAL FOODBORNE INFECTIONS NETWORK YEAR 2014

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List of Abbreviations

AMP, Ampicillin
AST, Antimicrobial Susceptibility Testing
ATCC, American Type Culture Collection
CAZ, Ceftazidime
CDC, Centers for Disease Control and Prevention
CHL, Chloramphenicol
CIP, Ciprofloxacin
CRO, Ceftriaxone
CTX, Cefotaxime
DTU Food, Technical University of Denmark - National Food Institute
EQAS, External Quality Assurance System
ERY, Erythromycin
ESBL, Extended Spectrum Beta-Lactamase
EU, European Union
GEN, Gentamicin
IP, Institute Pasteur
MIC, Minimum Inhibitory Concentration
NAL, Nalidixic Acid
NSSC, National *Salmonella* and *Shigella* Center, Thailand
PHAC, Public Health Agency of Canada
QC, Quality Control
SMX, Sulfamethoxazole
STR, Streptomycin
SXT, Trimethoprim + Sulphonamides
TET, Tetracycline
TMP, Trimethoprim
WHO, World Health Organization
WHO GFN, WHO Global Foodborne Infections Network

1. Introduction

Since 2000, 13 External Quality Assurance System (EQAS) reports have been issued with this report being the 14th. The WHO Global Foodborne Infections Network (WHO GFN) focuses on enhancing World Health Organization (WHO) Member States' capacity to detect and respond to foodborne disease outbreaks by conducting laboratory-based surveillance of *Salmonella* and other foodborne pathogens. Since its inception, the scope of WHO GFN has expanded to include additional foodborne pathogens like *Shigella* and *Campylobacter*. *Salmonella*, *Campylobacter* and *Shigella* are among the most important foodborne pathogens worldwide and account for millions of cases of diarrheal disease and thousands of deaths per year, impacting both developing and industrialized countries. Furthermore, the increased number of *Salmonella* and *Shigella* isolates which are resistant to antimicrobials is of major concern since these isolates are associated with infections characterized by increased morbidity and mortality.

The EQAS is organized annually by the Technical University of Denmark, National Food Institute (DTU Food), Kgs. Lyngby, Denmark in collaboration with Centers for Disease Control and Prevention (CDC) in Atlanta, USA; World Health Organization (WHO) in Geneva, Switzerland; Public Health Agency of Canada (PHAC) in Canada; National *Salmonella* and *Shigella* Center (NSSC), National Institute of Health, Department of Medical Science in Thailand and Institute Pasteur (IP) in Paris, France.

Individual laboratory data are confidential and only known by the participating laboratory, the EQAS Organizer (DTU Food) and possibly the respective WHO GFN regional centre. All summary conclusions are made public. The goal set by WHO GFN aims towards having all national reference laboratories perform *Salmonella* serotyping with a maximum of one deviation out of eight strains tested (error rate of 13%) and performing antimicrobial susceptibility testing (AST) of *Salmonella* and *Shigella* with a maximum error rate of 10% (either <5% very major / major errors and <5% minor errors, or <10% minor errors). Minor deviations are defined as classification of an intermediate strain as susceptible, resistant or vice versa (*i.e.* $I \leftrightarrow S$ or $I \leftrightarrow R$). Major deviation is the classification of a susceptible strain as resistant (*i.e.* $S \rightarrow R$). Very major deviation is the classification of a resistant strain as susceptible (*i.e.* $R \rightarrow S$). In this report, the deviations of AST results are divided into two categories, *i.e.* critical deviations which include major and very major deviations, and total deviations which include also the minor deviations. No quality threshold has been determined in relation to identification of *Campylobacter* ssp., serotyping of *Shigella*, or identification of the unknown foodborne pathogen.

In EQAS 2014, the regions were redefined for all countries worldwide. This led to some reorganization of countries into new regions compared to previous years, why interpreting region based results from 2014 and forward with results before 2014 should be done with care. The countries belonging to each region is listed in Appendix 1.

Appendices 2-5 present additional background information in relation to the WHO EQAS 2014.

2. Summary

The summary report is divided into five sections; the *Salmonella* components, the *Shigella* components, reporting of ESBL *Salmonella* and *Shigella*, the *Campylobacter* components, and identification of the unknown strain. All results reported in the summary can be found in Appendix 1.

***Salmonella* EQAS components**

The acceptance threshold for the EQAS *Salmonella* serotyping component was met by 68% (n = 102) of the 149 participating laboratories. In addition, 57% (n = 85) of the laboratories tested all eight strains with a total at 92% (n = 969) of all tests being correct, representing an increase compared to 2013. The ability to correctly serotype the internal control strain increased to the highest level at 98%, previously only observed in 2011.

On a region-based categorization of participating laboratories, the Caribbean, Central Asia & Middle East, Africa and Latin America all correctly serotyped between 60% and 90% of the test strains, where as China, Russia, Southeast Asia and Europe correctly serotyped between 90 and 99% of the test strains. North America and Oceania both serotyped all eight strains 100% correctly.

The main problem regarding the *Salmonella* serotyping appeared to be with WHO S-14.1 (Orion/Orion var. 15; 3,15:y:1,5), WHO S-14.4 (Napoli; 9,12:l,z13:e,n,x), and WHO S-14.5 (Ohio; 6,7:b:l,w), with 10%, 17% and 14% deviation, respectively.

Concerning the *Salmonella* AST component for the EQAS 2014, the performance recorded was maintained on a similar level as in the EQAS 2013, with low deviations of 3% minor, 1% major, and 1% very major deviations. Deviations categorized by the tested antimicrobials revealed that CIP caused the difficulties of the observed deviations (19%) most likely due to the often observed double zone when performing disk diffusion.

For the 155 laboratories performing the *Salmonella* AST component, only 74% (115 laboratories) reported data for AST of the control strain *E. coli* ATCC 25922. This is an alerting decrease, and it is of extreme importance to once again emphasize that this component represents the true indicator for the laboratory as to the performance of AST.

***Shigella* EQAS components**

The *Shigella* components included in the EQAS consist of serogrouping (i.e. the identification of the species), serotyping (i.e. the further typing of the species), and AST.

For the *Shigella* serogrouping component in EQAS 2014, the deviations observed ranged from 2.4% to 5.6%, for the four *Shigella* strains. This is an increase compared to the very low level of deviations observed in EQAS 2013, with a maximum of 0.9%.

The serotyping component was performed by a total of 83 laboratories for the two strains WHO 2014 SH-14.3 (*S. flexneri*; 2/2b) and WHO 2014 SH-14.4 (*S. boydii*; 2), with deviating results observed at 16.3% and 7.2%, respectively. The serotyping component was not required for the *S. sonnei* serogroup (WHO 2014 SH-14.1 and WHO 2014 SH-14.2). According to the geographical distribution of the participating laboratories, this year Caribbean was again represented. However,

the one laboratory representing the region did not manage to correctly serotype the one strain that they tested. The remaining results, on a region-based categorization, ranged from 58.3% (Africa) to 100% correctly serotyped strains.

For the results of the *Shigella* AST component, the number of participating laboratories increased to the levels before the EQAS 2013, with 116 participating laboratories in EQAS 2014. The results obtained were in 92% of the cases in agreement with the expected results and consistent with previous years. Minor, major and very major deviations were observed in 4%, 1%, and 3% of the reported results, respectively. Categorizing the tested antimicrobials according to the deviations revealed that CIP (34.2%) and CAZ (14.1%) caused difficulties in the AST component.

A region-based categorization of the results revealed correct test results between 76.5% (Caribbean) and 98.4% (Russia), with a very high level of critical deviations observed in Caribbean (18.4%), with the remaining regions all below 10%.

ESBL EQAS component

A part of the EQAS is to detect and confirm ESBL production in the *Salmonella* and *Shigella* strains. If participating in this component of the EQAS, all strains showing reduced susceptibility to cefotaxime (CTX), ceftazidime (CAZ) and/or ceftriaxone (CRO) should be tested for ESBL production.

For the EQAS 2014, one *Salmonella* ESBL-producer (WHO 2014 S-14.7) and two *Shigella* ESBL-producers (WHO 2014 SH-14.1 and WHO 2014 SH-14.2) were included. For the *Salmonella* strain, the gene accounting for the phenotype was CTX-M-3, and the two confirmatory tests (CAZ/Cl:CAZ and CTX/Cl:CTX) showed 11% and 13% of deviations in reporting correct results, respectively. For the *Shigella* strain WHO 2014 SH-14.1 (CTX-M-15), deviations of the confirmatory test results were observed to 9% and 8%, respectively. For the WHO 2014 SH-14.2 (CTX-M-15), the deviating results were observed to 12% and 8%, respectively.

***Campylobacter* EQAS components**

Interpretation of the results for *Campylobacter* in EQAS 2014 only included WHO 2014 C-14.2 due to the fact that the produced lyophilized WHO 2014 C-14.1 proved to be contaminated and therefore could not be distributed.

A total of 101 laboratories participated in the identification of the *C. coli* WHO 2014 C-14.2 strain with a result of 85% correct species identification. On a region-based characterization, the accuracy in *Campylobacter* identification ranged from 57% (Central Asia & Middle East) to 100% (Caribbean, North America, Oceania, and Russian regions).

Concerning the *Campylobacter* AST component in the EQAS 2014, 50 laboratories participated. The overall performance of the AST showed 1.6% major deviations, and 7.2% very major deviations, giving a total of 8.8% critical deviations, the highest level observed in the history of this WHO EQAS.

From the categorization of the antimicrobials, the results showed no problems when testing ERY and GEN. However, NAL, STR, and TET all showed deviations above 10% (11.9%, 16.7%, and

11.1%, respectively). On a region-based characterization, the performance in Africa is noteworthy, with a deviation level of 48.5% critical deviations, whereas Central Asia & Middle East, China, Caribbean, North America, and Latin America all perfectly performed the test without deviations. Europe and Southeast Asia reported deviations at 2.6% and 12.5%, respectively. In EQAS 2014 no laboratories in the Oceania or Russian regions participated in the *Campylobacter* AST component.

For the QC strain *Campylobacter jejuni* ATCC 33560 only 32 laboratories reported AST. Again, we have to emphasize the importance of including this component as it represents the true indicator for the laboratory's performance of AST. In EQAS 2014, the antimicrobials causing most problems were GEN and ERY, however the percentage of laboratories reporting correct AST results for these two compounds increased to 90% and 84% (compared to 82% and 83% in EQAS 2013), respectively.

Identification of unknown culture EQAS component

For this part of the EQAS, an unknown culture is provided for identification. In EQAS 2014, the unknown strain was the Gram negative *Yersinia pseudotuberculosis*.

A total of 122 laboratories participated in this component, with 74% identifying the strain correctly.

3. List of Appendices

Appendix 1: Figures and Tables

Appendix 2: Prenotification

Appendix 3: Expected results

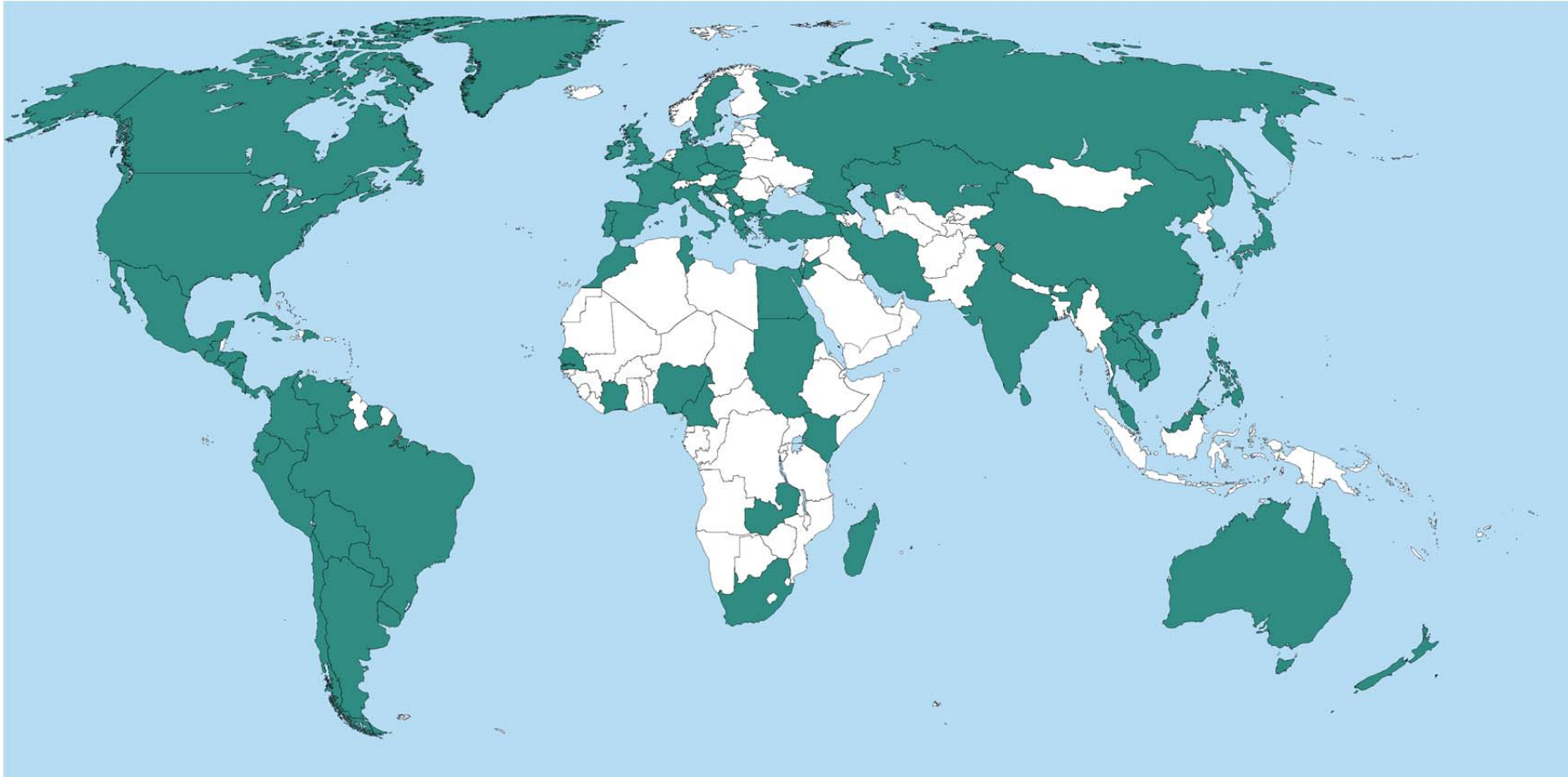
Appendix 4: WHO EQAS 2014 Protocol

Appendix 5a: Subculture and Maintenance of Quality Control Strains

Appendix 5b: Instructions for Opening and Reviving Lyophilized Cultures

Figure and Tables

Figure 1. Countries participating* in the WHO EQAS 2014



*marked in green

List of Countries in the 10 Regions

Africa

| | | |
|-----------------------------------|------------------------|------------------------------|
| Algeria | Gabon | Reunion |
| Angola | Gambia | Rwanda |
| Benin | Ghana | Saint Helena |
| Botswana | Guinea | Sao Tome and Principe |
| Burkina Faso | Guinea-Bissau | Senegal |
| Burundi | Kenya | Seychelles |
| Cameroon | Lesotho | Sierra Leone |
| Cameroun | Liberia | Somalia |
| Cape Verde | Libyan Arab Jamahiriya | South Africa |
| Central African Republic | Madagascar | South Sudan |
| Chad | Malawi | Sudan |
| Comoros | Mali | Swaziland |
| Congo (Brazzaville) | Mauritania | Tanzania, United Republic of |
| Congo, Democratic Republic of the | Mauritius | Togo |
| Cote d'Ivoire (Ivory Coast) | Mayotte | Tunisia |
| Djibouti | Morocco | Uganda |
| Egypt | Mozambique | Western Sahara |
| Equatorial Guinea | Namibia | Zambia |
| Eritrea | Niger | Zimbabwe |
| Ethiopia | Nigeria | |

Caribbean

| | | |
|-----------------------------------|--------------------|----------------------------------|
| Anguilla | Dominica | Saint Martin |
| Antigua and Barbuda | Dominican Republic | Saint Vincent and the Grenadines |
| Aruba | Grenada | Saint-Barthélemy |
| Bahamas | Guadeloupe | Sint Maarten |
| Barbados | Haiti | St. Kitts and Nevis |
| Bonaire, Saint Eustatius and Saba | Jamaica | Trinidad and Tobago |
| British Virgin Islands | Martinique | Turks and Caicos Islands |
| Cayman Islands | Montserrat | Virgin Islands (US) |
| Cuba | Puerto Rico | |
| Curaçao | Saint Lucia | |

Central Asia & Middle East

| | | |
|-----------------------|--------------------|----------------------|
| Afganistan | Israel | Pakistan |
| Armenia | Jordan | Palestine |
| Azerbaijan | Kazakhstan | Qatar |
| Bahrain | Kuwait | Saudi Arabia |
| Bangladesh | Kyrgyzstan | Syria |
| Bhutan | Lebanon | Tajikistan |
| Georgia | Macao | Timor Leste (West) |
| Hong Kong | Maldives | Turkmenistan |
| India | Mongolia | United Arab Emirates |
| Indonesia | Myanmar (ex-Burma) | Uzbekistan |
| Iran, Islamic rep. Of | Nepal | Yemen |
| Iraq | Oman | |

China

China

Europe

| | | |
|---------|----------------------|----------|
| Albania | Guerney and Alderney | Norway |
| Andorra | Hungary | Poland |
| Austria | Iceland | Portugal |

Belarus
Belgium
Bosnia
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
European Union
Faroe Islands
Finland
France
Germany
Gibraltar
Greece

Ireland
Italy
Jersey
Kosova
Kosovo
Latvia
Liechtenstein
Lithuania
Luxembourg
Macedonia
Malta
Man, Island of
Moldova
Monaco
Montenegro
Netherlands

Romania
San Marino
Serbia
Slovak Republic
Slovakia
Slovenia
Spain
Svalbard and Jan Mayen Islands
Sweden
Switzerland
Turkey
Ukraine
United Kingdom
Vatican City State (Holy See)

Latin America

Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Ecuador

El Salvador
Falkland Islands (Malvinas)
French Guiana
Guatemala
Guyana
Honduras
Mexico

Nicaragua
Panama
Paraguay
Peru
Suriname
Uruguay
Venezuela

North America

Bermuda
Canada

Greenland
Saint Pierre and Miquelon

United States of America

Oceania

Australia
Kiribati
New Zealand
Solomon, Islands
Fiji
Marshall Islands

Papua New Guinea
Tonga
French Polynesia
Micronesia
Samoa
Tuvalu

Guam
New Caledonia
Samoa, American
Vanuatu

Russia

Russia

Southeast Asia

Brunei Darussalam
Cambodia
Japan
Korea, North
Korea, Rep of

Lao PDR
Malaysia
Philippines
Singapore
Sri Lanka

Taiwan
Thailand
Viet Nam

Table 1. EQAS participating laboratories' performance of *Salmonella* serotyping

| EQAS iteration | Labs serotyping all provided strains | | Correct test results | |
|----------------|--------------------------------------|----|----------------------|----|
| | No. | % | No. | % |
| 2000 | 34 | 92 | 165 | 76 |
| 2001 | 79 | 82 | 513 | 72 |
| 2002 | 80 | 81 | 668 | 91 |
| 2003 | 69 | 54 | 692 | 80 |
| 2004 | 78 | 61 | 701 | 81 |
| 2006 | 105 | 81 | 808 | 85 |
| 2007 | 109 | 78 | 920 | 88 |
| 2008 | 100 | 66 | 888 | 83 |
| 2009 | 119 | 83 | 974 | 86 |
| 2010 | 129 | 87 | 998 | 89 |
| 2011 | 109 | 89 | 878 | 92 |
| 2012 | 122 | 81 | 936 | 83 |
| 2013 | 74 | 59 | 812 | 89 |
| 2014 | 85 | 57 | 969 | 92 |
| Average | 97 | 75 | 780 | 85 |

Table 2. Ability of EQAS participating laboratories to serotype the test *Salmonella* strains

| Number of strains correctly serotyped | Participating laboratories | | | | | | | | | | | | | | | |
|---------------------------------------|----------------------------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|--------------------------|-----|
| | EQAS 2000 | | EQAS 2001 | | EQAS 2002 | | EQAS 2003 | | EQAS 2004 | | EQAS 2006 | | EQAS 2007 | | | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | | |
| 8 | 9 | 24 | 34 | 35 | 52 | 53 | 66 | 47 | 41 | 32 | 42 | 32 | 66 | 47 | | |
| 7 | 9 | 24 | 13 | 14 | 19 | 19 | 29 | 21 | 14 | 11 | 35 | 27 | 29 | 21 | | |
| 6 | 4 | 11 | 9 | 9 | 12 | 12 | 13 | 9 | 16 | 13 | 19 | 15 | 13 | 9 | | |
| 5 | 3 | 8 | 9 | 9 | 4 | 4 | 11 | 8 | 16 | 13 | 12 | 9 | 11 | 8 | | |
| 4 | 3 | 8 | 4 | 4 | 1 | 1 | 7 | 5 | 11 | 9 | 7 | 5 | 7 | 5 | | |
| 3 | 4 | 11 | 8 | 8 | 4 | 4 | 6 | 4 | 10 | 8 | 5 | 4 | 6 | 4 | | |
| 2 | 2 | 5 | 3 | 3 | 5 | 5 | 2 | 1 | 10 | 8 | 3 | 2 | 2 | 1 | | |
| 1 | 2 | 5 | 5 | 5 | 1 | 1 | 6 | 4 | 5 | 4 | 4 | 3 | 6 | 4 | | |
| 0 | 1 | 3 | 11 | 11 | 1 | 1 | 0 | 0 | 4 | 3 | 3 | 2 | 0 | 0 | | |
| In total | 37 | 100 | 96 | 100 | 99 | 100 | 127 | 100 | 127 | 100 | 130 | 100 | 140 | 100 | | |
| Number of strains correctly serotyped | Participating laboratories | | | | | | | | | | | | | | | |
| | EQAS 2008 | | EQAS 2009 | | EQAS 2010 | | EQAS 2011 | | EQAS 2012 | | EQAS 2013 | | EQAS 2014 | | AVERAGE EQAS 2000 - 2014 | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| 8 | 50 | 33 | 76 | 50 | 91 | 61 | 82 | 67 | 68 | 47 | 52 | 41 | 70 | 47 | 57 | 44 |
| 7 | 36 | 24 | 29 | 19 | 16 | 11 | 17 | 14 | 29 | 20 | 29 | 23 | 32 | 21 | 24 | 19 |
| 6 | 11 | 7 | 7 | 5 | 12 | 8 | 10 | 8 | 14 | 10 | 15 | 12 | 17 | 11 | 12 | 10 |
| 5 | 14 | 9 | 13 | 8 | 9 | 6 | 2 | 2 | 9 | 6 | 8 | 6 | 6 | 4 | 9 | 7 |
| 4 | 12 | 8 | 5 | 3 | 6 | 5 | 4 | 3 | 5 | 3 | 7 | 6 | 5 | 3 | 6 | 5 |
| 3 | 9 | 6 | 7 | 5 | 2 | 1 | 4 | 3 | 6 | 4 | 7 | 6 | 7 | 5 | 6 | 5 |
| 2 | 8 | 6 | 5 | 3 | 2 | 1 | 1 | 1 | 10 | 7 | 6 | 5 | 4 | 3 | 5 | 4 |
| 1 | 9 | 6 | 6 | 4 | 7 | 5 | 3 | 2 | 2 | 1 | 2 | 2 | 4 | 3 | 4 | 4 |
| 0 | 2 | 1 | 5 | 3 | 3 | 2 | 0 | 0 | 1 | 1 | 0 | 0 | 4 | 3 | 3 | 2 |
| In total | 151 | 100 | 153 | 100 | 148 | 100 | 123 | 100 | 144 | 100 | 126 | 100 | 149 | 100 | 125 | 100 |

Table 3. Region-based categorization of EQAS participants' performance of *Salmonella* serotyping

| Region | EQAS iteration | No. of labs | No. of strains serotyped | % strains correctly serotyped | Countries participating in EQAS 2014 |
|----------------------------|----------------|-------------|--------------------------|-------------------------------|--|
| Africa | 2001 | 6 | 37 | 73.0 | Cameroun, Egypt, Gambia, Kenya (2), Madagascar, Mauritius, Morroco, Senegal, South Africa, Tunisia |
| | 2002 | 9 | 62 | 87.1 | |
| | 2003 | 11 | 70 | 71.4 | |
| | 2004 | 9 | 51 | 62.7 | |
| | 2006 | 16 | 95 | 71.6 | |
| | 2007 | 11 | 73 | 80.8 | |
| | 2008 | 10 | 71 | 49.3 | |
| | 2009 | 15 | 94 | 75.5 | |
| | 2010 | 13 | 83 | 67.5 | |
| | 2011 | 10 | 57 | 79.2 | |
| | 2012 | 10 | 65 | 60.0 | |
| | 2013 | 8 | 51 | 74.5 | |
| | 2014 | 11 | 63 | 76.2 | |
| Central Asia & Middle East | 2001 | 10 | 60 | 50.0 | Bahrain, Georgia, India (2), Israel, Jordan, Kazakhstan |
| | 2002 | 5 | 30 | 83.3 | |
| | 2003 | 5 | 35 | 54.3 | |
| | 2004 | 5 | 33 | 54.5 | |
| | 2006 | 5 | 35 | 74.3 | |
| | 2007 | 5 | 40 | 55.0 | |
| | 2008 | 5 | 34 | 61.8 | |
| | 2009 | 5 | 32 | 46.9 | |
| | 2010 | 5 | 22 | 75.9 | |
| | 2011 | 3 | 23 | 95.8 | |
| | 2012 | 4 | 30 | 56.7 | |
| | 2013 | 5 | 38 | 52.6 | |
| | 2014 | 7 | 37 | 75.7 | |
| Caribbean | 2001 | 0 | 0 | 0 | Barbados, Cuba, Jamaica |
| | 2002 | 0 | 0 | 0 | |
| | 2003 | 3 | 18 | 61.1 | |
| | 2004 | 2 | 8 | 87.5 | |
| | 2006 | 3 | 14 | 78.6 | |
| | 2007 | 2 | 9 | 77.8 | |
| | 2008 | 3 | 14 | 78.6 | |
| | 2009 | 3 | 12 | 83.3 | |
| | 2010 | 2 | 13 | 92.9 | |
| | 2011 | 1 | 7 | 87.5 | |
| | 2012 | 2 | 16 | 62.5 | |
| | 2013 | 1 | 5 | 100.0 | |
| | 2014 | 3 | 15 | 60.0 | |
| Europe | 2001 | 43 | 323 | 80.5 | Albania, Belgium, Bulgaria, Croatia (2), Cyprus, Czech Republic (2), Denmark (2), France, Germany (2), Greece (3), Hungary, Ireland, Italy (18), Kosova, Luxembourg (2), Malta, Poland (3), Portugal, Serbia (2), Slovak Republic, Slovenia, Spain, Sweden, Turkey, United Kingdom |
| | 2002 | 50 | 384 | 90.0 | |
| | 2003 | 60 | 401 | 84.8 | |
| | 2004 | 57 | 392 | 84.7 | |
| | 2006 | 52 | 403 | 86.4 | |
| | 2007 | 54 | 415 | 89.4 | |
| | 2008 | 50 | 379 | 82.3 | |
| | 2009 | 47 | 362 | 93.1 | |
| | 2010 | 45 | 332 | 94.1 | |
| | 2011 | 42 | 314 | 94.6 | |
| | 2012 | 47 | 368 | 92.9 | |
| | 2013 | 42 | 309 | 94.5 | |
| | 2014 | 52 | 391 | 96.2 | |

Table 3 (continued). Region-based categorization of EQAS participants' performance of *Salmonella* serotyping

| Region | EQAS iteration | No. of labs | No. of strains serotyped | % strains correctly serotyped | Countries participating in EQAS 2014 |
|---------------|----------------|-------------|--------------------------|-------------------------------|--|
| North America | 2001 | 4 | 32 | 87.5 | Canada (10), USA (3) |
| | 2002 | 2 | 16 | 100.0 | |
| | 2003 | 6 | 41 | 95.1 | |
| | 2004 | 8 | 55 | 81.8 | |
| | 2006 | 10 | 80 | 96.3 | |
| | 2007 | 12 | 94 | 97.9 | |
| | 2008 | 11 | 84 | 95.2 | |
| | 2009 | 12 | 90 | 92.2 | |
| | 2010 | 13 | 103 | 100.0 | |
| | 2011 | 11 | 81 | 97.6 | |
| | 2012 | 14 | 101 | 93.1 | |
| | 2013 | 13 | 92 | 97.8 | |
| | 2014 | 13 | 84 | 100.0 | |
| Oceania | 2001 | 4 | 30 | 100.0 | Australia (3), New Zealand |
| | 2002 | 6 | 43 | 93.0 | |
| | 2003 | 6 | 46 | 93.5 | |
| | 2004 | 5 | 38 | 97.4 | |
| | 2006 | 5 | 37 | 94.6 | |
| | 2007 | 4 | 32 | 100.0 | |
| | 2008 | 4 | 30 | 93.3 | |
| | 2009 | 4 | 32 | 96.9 | |
| | 2010 | 4 | 32 | 100.0 | |
| | 2011 | 4 | 32 | 100.0 | |
| | 2012 | 4 | 32 | 100.0 | |
| | 2013 | 4 | 31 | 100.0 | |
| | 2014 | 4 | 32 | 100.0 | |
| Russia | 2001 | 1 | 8 | 12.5 | Russia (4) |
| | 2002 | 1 | 8 | 62.5 | |
| | 2003 | 1 | 7 | 14.3 | |
| | 2004 | 4 | 26 | 69.2 | |
| | 2006 | 5 | 40 | 80.0 | |
| | 2007 | 8 | 51 | 80.4 | |
| | 2008 | 6 | 40 | 90.0 | |
| | 2009 | 7 | 49 | 91.8 | |
| | 2010 | 8 | 54 | 87.1 | |
| | 2011 | 7 | 48 | 87.3 | |
| | 2012 | 6 | 48 | 87.5 | |
| | 2013 | 2 | 16 | 75.0 | |
| | 2014 | 4 | 30 | 93.3 | |
| Latin America | 2001 | 11 | 78 | 57.7 | Argentina, Bolivia, Brazil (2), Chile (2), Colombia (3), Costa Rica (2), Honduras, Mexico (3), Nicaragua, Panama (2), Paraguay, Peru, Uruguay (2), Venezuela (2) |
| | 2002 | 11 | 82 | 87.8 | |
| | 2003 | 13 | 83 | 75.9 | |
| | 2004 | 15 | 88 | 79.5 | |
| | 2006 | 13 | 84 | 84.5 | |
| | 2007 | 15 | 107 | 88.8 | |
| | 2008 | 17 | 120 | 71.7 | |
| | 2009 | 21 | 150 | 77.3 | |
| | 2010 | 22 | 132 | 80.0 | |
| | 2011 | 23 | 144 | 83.7 | |
| | 2012 | 25 | 182 | 73.1 | |
| | 2013 | 22 | 154 | 83.1 | |
| | 2014 | 24 | 166 | 84.9 | |

Table 3 (continued). Region-based categorization of EQAS participants' performance of *Salmonella* serotyping

| Region | EQAS iteration | No. of labs | No. of strains serotyped | % strains correctly serotyped | Countries participating in EQAS 2014 |
|----------------|----------------|-------------|--------------------------|-------------------------------|--|
| Southeast Asia | 2001 | 15 | 113 | 54.0 | Brunei Darussalam, Cambodia, Japan (2), LAO PDR, Malaysia (4), Philippines, Rep of Korea (2), Singapore, Sri Lanka, Taiwan, Thailand (6), Viet Nam |
| | 2002 | 12 | 90 | 92.2 | |
| | 2003 | 15 | 100 | 81.0 | |
| | 2004 | 17 | 130 | 81.5 | |
| | 2006 | 15 | 117 | 84.6 | |
| | 2007 | 19 | 140 | 91.4 | |
| | 2008 | 18 | 125 | 81.6 | |
| | 2009 | 23 | 180 | 81.1 | |
| | 2010 | 24 | 172 | 90.5 | |
| | 2011 | 23 | 180 | 98.4 | |
| | 2012 | 28 | 207 | 77.8 | |
| | 2013 | 22 | 163 | 89.6 | |
| | 2014 | 22 | 166 | 94.6 | |
| China | 2001 | 4 | 32 | 96.9 | China (9) |
| | 2002 | 3 | 24 | 100.0 | |
| | 2003 | 8 | 60 | 75.0 | |
| | 2004 | 7 | 46 | 78.3 | |
| | 2006 | 6 | 48 | 85.4 | |
| | 2007 | 10 | 80 | 91.3 | |
| | 2008 | 15 | 108 | 94.4 | |
| | 2009 | 16 | 126 | 95.2 | |
| | 2010 | 10 | 74 | 92.5 | |
| | 2012 | 10 | 78 | 80.8 | |
| | 2013 | 7 | 54 | 92.6 | |
| | 2014 | 9 | 71 | 93.0 | |

Table 4. *Salmonella* serogroups (SG), serotypes (ST) and deviations (D), WHO EQAS 2014

| Strain ID | Correct serotype | | No. of labs reporting SG | % D _{SG} | No. of labs reporting ST | % D _{ST} | Deviating results (*) |
|------------|-----------------------|--------------------|--------------------------|-------------------|--------------------------|-------------------|---|
| WHO S-14.1 | Orion / Orion var. 15 | I 3,15:y:1,5 | 153 | 4.6 | 137 | 10.2 | Amager, Amounderness, Elisabethville, Florian, Fufu, Gatineau(3), Gbadago, II 3,10:z:1,5, Lexington var. 15+, Meleagridis, Paratyphi A, Stockholm |
| WHO S-14.2 | Hadar / Istanbul | I 8:z10:e,n,x | 158 | 3.8 | 137 | 6.6 | Chomedy, Haifa, Mapo, Molade, Newport, Paratyphi C, Santiago, Virginia, Zerifin |
| WHO S-14.3 | IIIa 48:g,z51:- | IIIa 48:g,z51:- | 106 | 10.4 | 90 | 7.8 | Choleraesuis, Enteritidis, Fitzroy 48:e,h:1,5, II 48:g,m,t:-, IIIb 48:i:z, IV 48:g,z51:-, IV 6,7:z36:- |
| WHO S-14.4 | Napoli | I 9,12:l,z13:e,n,x | 155 | 3.9 | 133 | 16.5 | Bournemouth, Claibornei, Dublin, Enteritidis, Fallowfield, II .1.,9,12:b:e,n,x, II .1.,9,12:l,w:e,n,x, Itami, Javiana(2), Kapemba, Mahina, Miyazaki, Nordrhein, Zaiman(8) |
| WHO S-14.5 | Ohio | I 6,7:b:l,w | 157 | 1.9 | 133 | 14.3 | Bonariensis, Colorado(2), Coromandel, Edinburg, Gabon(2), II 6,7:l,z28:1,5:[z42], Infantis(4), Isangi, Jerusalem, Langeveld(4), Montevideo |
| WHO S-14.6 | Enteritidis | I 9,12:g,m:- | 156 | 0.6 | 145 | 2.1 | Antarctica, Macclesfield, Panama |
| WHO S-14.7 | Typhimurium | I 4,12:i:1,2 | 160 | 1.3 | 141 | 4.3 | Agama, Farsta, Gloucester(2), Lagos, Tripoli |
| WHO S-14.8 | Kentucky | I 8:i:z6 | 157 | 4.5 | 139 | 4.3 | Agama, Hadar, Newport, Paratyphi A, Stuttgart, Warnow |

*number of participants reporting the specified deviating result

Table 5. EQAS participating laboratories' performance of internal quality control strain (WHO S-14.6, *Salmonella* Enteritidis) serotyping

| EQAS iteration | Labs serotyping <i>S. Enteritidis</i> correctly | |
|----------------|---|----|
| | No. | % |
| 2000 | 34 | 92 |
| 2001 | 64 | 84 |
| 2004 | 113 | 95 |
| 2006 | 116 | 94 |
| 2007 | 135 | 96 |
| 2008 | 139 | 96 |
| 2009 | 141 | 93 |
| 2010 | 138 | 97 |
| 2011 | 128 | 98 |
| 2012 | 139 | 96 |
| 2013 | 130 | 96 |
| 2014 | 145 | 98 |
| Average | 119 | 95 |

Table 6. EQAS participating laboratories' performance of antimicrobial susceptibility testing of *Salmonella* strains

| EQAS iteration | No. of EQAS participating laboratories | % correct test results | % minor deviations (S ↔ I or I ↔ R)^ | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (R → S & S → R)^ | % total deviations (S → R & R → S & S ↔ I or I ↔ R)^ |
|----------------|--|------------------------|---|--------------------------------|-------------------------------------|---|---|
| 2000 | 44 | 92 | 4 | 4 | 0 | 4 | 8 |
| 2001 | 108 | 91 | 6 | 2 | 1 | 3 | 9 |
| 2002 | 119 | 92 | 6 | 2 | 1 | 3 | 9 |
| 2003* | 147 | 93 | 4 | 3 | 0 | 3 | 7 |
| 2004 | 152 | 93 | 4 | 2 | 1 | 3 | 7 |
| 2006 | 143 | 88 | 8 | 3 | 1 | 4 | 12 |
| 2007 | 143 | 93 | 4 | 2 | 1 | 3 | 7 |
| 2008 | 168 | 91 | 4 | 2 | 3 | 5 | 9 |
| 2009 | 153 | 94 | 3 | 2 | 1 | 3 | 6 |
| 2010 | 152 | 92 | 4 | 3 | 2 | 5 | 8 |
| 2011 | 127 | 91 | 4 | 2 | 3 | 5 | 9 |
| 2012 | 159 | 94 | 3 | 2 | 1 | 3 | 6 |
| 2013 | 145 | 95 | 3 | 2 | 0 | 2 | 5 |
| 2014 | 155 | 95 | 3 | 1 | 1 | 2 | 5 |
| Average* | 137 | 93 | 4 | 2 | 1 | 3 | 8 |

*Data do not include one strain which may have lost resistance due to transport or storage stress

^S, susceptible; I, intermediate; R, resistant

Table 7. Antimicrobial susceptibility test results (number of R/I/S) for the EQAS 2014 *Salmonella* strains*

| Strain | Antimicrobial [^] | | | | | | | | | | | |
|------------|----------------------------|---------|---------|---------|---------|----------|-----------|---------|--------|----------|---------|--------|
| | AMP | CTX | CAZ | CRO | CHL | CIP | GEN | NAL | SMX | TET | SXT | TMP |
| WHO S-14.1 | 5/1/141 | 2/1/125 | 3/2/121 | 0/1/101 | 1/0/133 | 1/12/132 | 2/2/139 | 1/1/132 | 4/1/64 | 3/2/133 | 2/1/127 | 0/0/69 |
| WHO S-14.2 | 4/0/144 | 3/1/123 | 1/1/124 | 1/2/99 | 2/1/131 | 21/80/44 | 3/2/139 | 133/0/3 | 8/0/63 | 133/3/4 | 3/0/128 | 0/0/67 |
| WHO S-14.3 | 4/0/143 | 0/0/126 | 0/0/126 | 0/0/101 | 0/0/133 | 0/4/140 | 5/0/138 | 2/0/133 | 1/0/70 | 3/1/136 | 0/1/128 | 0/0/67 |
| WHO S-14.4 | 144/0/3 | 2/1/124 | 3/2/119 | 0/0/103 | 0/0/135 | 3/9/134 | 2/2/140 | 2/2/131 | 69/0/0 | 135/1/4 | 122/0/8 | 64/0/2 |
| WHO S-14.5 | 2/2/142 | 0/0/126 | 3/0/122 | 0/0/102 | 0/2/132 | 0/10/135 | 3/1/140 | 3/1/130 | 5/2/62 | 3/6/129 | 2/0/128 | 0/0/66 |
| WHO S-14.6 | 10/10/127 | 5/5/117 | 8/0/117 | 1/0/101 | 0/7/128 | 0/13/131 | 134/4/6 | 1/3/132 | 60/0/9 | 7/11/120 | 2/0/127 | 0/0/66 |
| WHO S-14.7 | 145/0/2 | 119/1/6 | 114/6/5 | 100/0/5 | 129/3/1 | 46/69/30 | 136/3/3 | 132/0/1 | 73/0/0 | 135/0/1 | 128/0/1 | 68/0/2 |
| WHO S-14.8 | 144/0/3 | 5/1/121 | 7/2/117 | 4/1/95 | 3/0/131 | 137/4/6 | 120/11/12 | 133/0/2 | 67/0/3 | 133/1/3 | 5/1/125 | 5/0/65 |

[^]For antimicrobial abbreviations: see List of Abbreviations page 1

*In bold: expected interpretation. Grey cell: <90% of laboratories did correct interpretation. R, resistant/I, intermediate/ S, susceptible.

Table 8. EQAS participants' performance of *Salmonella* strains antimicrobial susceptibility testing categorized by antimicrobial

| EQAS iteration | No. of labs | Performance | Antimicrobial ^{co} | | | | | | | | | | | | | | | | | |
|----------------|-------------|------------------------|-----------------------------|-------|-----|-------|-------|-----|-----|-------|-------|-----|-------|-----|-----|-------|-------|-----|-----|---------|
| | | | AMC | AMP | CAZ | CHL | CIP | POD | CRO | CTX | GEN | KAN | NAL | SMX | STR | SXT | TET | TMP | XNL | OVERALL |
| 2000 | 44 | No. of tests | - | 343 | - | 343 | 334 | - | | | 343 | 312 | 328 | 248 | 312 | - | 335 | 295 | - | 3,193 |
| | | % critical deviations* | - | 6 | - | 4 | 1 | - | | | 4 | 4 | 1 | 3 | 4 | - | 6 | 1 | - | 3 |
| | | % total deviations^ | - | 8 | - | 7 | 6 | - | | | 5 | 16 | 4 | 5 | 12 | - | 13 | 1 | - | 8 |
| 2001 | 108 | No. of tests | - | 822 | - | 814 | 813 | - | | | 821 | 623 | 726 | 431 | 679 | 757 | 804 | 416 | - | 7,706 |
| | | % critical deviations* | - | 4 | - | 2 | 1 | - | | | 2 | 2 | 2 | 6 | 7 | 2 | 7 | 1 | - | 3 |
| | | % total deviations^ | - | 7 | - | 3 | 4 | - | | | 4 | 7 | 8 | 9 | 27 | 5 | 18 | 2 | - | 9 |
| 2002 | 119 | No. of tests | - | 918 | - | 903 | 911 | - | | | 905 | 680 | 885 | 495 | 718 | 724 | 861 | 499 | - | 8,499 |
| | | % critical deviations* | - | 2 | - | 2 | 0 | - | | | 2 | 2 | 2 | 4 | 4 | 7 | 3 | 3 | - | 3 |
| | | % total deviations^ | - | 3 | - | 3 | 2 | - | | | 16 | 10 | 4 | 4 | 34 | 10 | 7 | 3 | - | 9 |
| 2003* | 147 | No. of tests | - | 1,019 | - | 996 | 995 | - | | | 993 | 738 | 947 | 615 | 768 | 929 | 995 | 582 | - | 9,577 |
| | | % critical deviations* | - | 2 | - | 1 | 0 | - | | | 2 | 2 | 1 | 4 | 9 | 2 | 4 | 1 | - | 3 |
| | | % total deviations^ | - | 4 | - | 2 | 1 | - | | | 2 | 6 | 4 | 5 | 39 | 2 | 11 | 1 | - | 7 |
| 2004 | 152 | No. of tests | 973 | 1,178 | - | 1,159 | 1,162 | - | - | 995 | 1,201 | - | 1,130 | 734 | 947 | 1051 | 1,122 | 729 | - | 12,381 |
| | | % critical deviations* | 6 | 3 | - | 2 | 0 | - | - | 0 | 2 | - | 1 | 5 | 1 | 3 | 5 | 2 | - | 3 |
| | | % total deviations^ | 12 | 5 | - | 2 | 1 | - | - | 14 | 3 | - | 4 | 8 | 21 | 4 | 11 | 2 | - | 7 |
| 2006 | 143 | No. of tests | 950 | 1,092 | 769 | 1,060 | 1,110 | 305 | - | 956 | 1,078 | - | 1,035 | 649 | 896 | 996 | 1,054 | 607 | 225 | 12,782 |
| | | % critical deviations* | 9 | 2 | 7 | 3 | 2 | 1 | - | 7 | 3 | - | 2 | 6 | 5 | 3 | 9 | 1 | 2 | 4 |
| | | % total deviations^ | 22 | 3 | 11 | 15 | 6 | 26 | - | 15 | 7 | - | 6 | 7 | 22 | 5 | 20 | 2 | 9 | 12 |
| 2007 | 143 | No. of tests | 908 | 1,114 | 830 | 1,105 | 1,101 | 389 | - | 914 | 1,111 | - | 1,092 | 678 | 875 | 971 | 1,047 | 583 | 258 | 12,976 |
| | | % critical deviations* | 6 | 5 | 1 | 0 | 1 | 4 | - | 1 | 3 | - | 2 | 5 | 4 | 3 | 4 | 1 | 0 | 3 |
| | | % total deviations^ | 17 | 7 | 1 | 6 | 1 | 16 | - | 2 | 4 | - | 3 | 6 | 26 | 3 | 11 | 2 | 6 | 7 |
| 2008 | 168 | No. of tests | - | 1,331 | 961 | 1,226 | 1,307 | - | 791 | 1,104 | 1,265 | - | 1,168 | 718 | 867 | 1,155 | 1,249 | 696 | - | 13,858 |
| | | % critical deviations* | - | 3 | 3 | 1 | 19 | - | 3 | 3 | 4 | - | 2 | 4 | 7 | 3 | 6 | 2 | - | 5 |
| | | % total deviations^ | - | 8 | 6 | 11 | 21 | - | 6 | 6 | 6 | - | 4 | 5 | 25 | 4 | 13 | 2 | - | 9 |
| 2009 | 153 | No. of tests | - | 1,206 | 921 | 1,108 | 1,190 | - | 775 | 1,009 | 1,143 | - | 1,095 | 624 | 864 | 1,042 | 1,114 | 616 | - | 12,707 |
| | | % critical deviations* | - | 3 | 1 | 1 | 8 | - | 0 | 1 | 2 | - | 1 | 7 | 9 | 3 | 4 | 1 | - | 3 |
| | | % total deviations^ | - | 6 | 1 | 2 | 10 | - | 1 | 2 | 3 | - | 3 | 9 | 30 | 4 | 10 | 1 | - | 6 |
| 2010 | 152 | No. of tests | - | 1,173 | 937 | 1,118 | 1,194 | - | 787 | 1,026 | 1,133 | - | 1,096 | 566 | 800 | 1,012 | 1,134 | 604 | - | 12,580 |
| | | % critical deviations* | - | 4 | 2 | 1 | 3 | - | 4 | 4 | 5 | - | 1 | 14 | 19 | 4 | 5 | 1 | - | 5 |
| | | % total deviations^ | - | 5 | 3 | 2 | 3 | - | 8 | 8 | 6 | - | 2 | 17 | 55 | 4 | 9 | 1 | - | 9 |

Table 8 (continued). EQAS participants' performance of *Salmonella* strains antimicrobial susceptibility testing categorized by antimicrobial.

| EQAS iteration | No. of labs | Performance | Antimicrobial [∞] | | | | | | | | | | | | | | | | | |
|----------------------|-------------|------------------------|----------------------------|------|------|------|------|-----|-----|------|------|-----|------|-----|-----|------|------|-----|-----|---------|
| | | | AMC | AMP | CAZ | CHL | CIP | POD | CRO | CTX | GEN | KAN | NAL | SMX | STR | SXT | TET | TMP | XNL | OVERALL |
| 2011 | 127 | No. of tests | - | 1099 | 829 | 988 | 1070 | - | 744 | 909 | 999 | - | 993 | 542 | 682 | 988 | 1017 | 493 | - | 11,353 |
| | | % critical deviations* | - | 5 | 3 | 2 | 20 | - | 3 | 4 | 4 | - | 7 | 4 | 3 | 3 | 4 | 1 | - | 5 |
| | | % total deviations^ | - | 6 | 4 | 2 | 21 | - | 3 | 6 | 5 | - | 15 | 5 | 42 | 3 | 10 | 2 | - | 9 |
| 2012 | 159 | No. of tests | - | 1228 | 993 | 1159 | 1245 | - | 834 | 1058 | 1161 | - | 1136 | 584 | 814 | 1054 | 1163 | 613 | - | 13,042 |
| | | % critical deviations* | - | 3 | 2 | 1 | 11 | - | 2 | 4 | 3 | - | 2 | 5 | 2 | 1 | 2 | 1 | - | 3 |
| | | % total deviations^ | - | 5 | 2 | 2 | 12 | - | 3 | 5 | 4 | - | 4 | 7 | 35 | 2 | 5 | 1 | - | 7 |
| 2013 | 145 | No. of tests | - | 1121 | 898 | 1027 | 1134 | - | 763 | 1011 | 1086 | - | 1027 | 491 | - | 946 | 1060 | 545 | - | 11,109 |
| | | % critical deviations* | - | 2 | 3 | 0 | 2 | - | 1 | 3 | 3 | - | 2 | 4 | - | 2 | 3 | 2 | - | 2 |
| | | % total deviations^ | - | 3 | 3 | 1 | 18 | - | 2 | 6 | 6 | - | 6 | 5 | - | 2 | 5 | 2 | - | 5 |
| 2014 | 155 | No. of tests | - | 1176 | 1003 | 1072 | 1161 | - | 817 | 1014 | 1147 | - | 1078 | 561 | - | 1039 | 1107 | 541 | - | 11716 |
| | | % critical deviations* | - | 3 | 3 | 1 | 3 | - | 1 | 2 | 3 | - | 1 | 5 | - | 2 | 3 | 2 | - | 2 |
| | | % total deviations^ | - | 4 | 4 | 2 | 19 | - | 2 | 3 | 5 | - | 2 | 6 | - | 3 | 5 | 2 | - | 5 |
| Average [•] | 137 | No. of tests | 944 | 1059 | 905 | 937 | 904 | 347 | 787 | 1000 | 1028 | 588 | 909 | 567 | 769 | 974 | 1004 | 559 | 242 | 10154 |
| | | % critical deviations* | 7 | 3 | 2 | 1 | 5 | 3 | 2 | 2 | 3 | 3 | 2 | 5 | 6 | 3 | 4 | 1 | 1 | 3 |
| | | % total deviations^ | 17 | 5 | 4 | 3 | 10 | 21 | 4 | 7 | 5 | 10 | 5 | 7 | 31 | 4 | 10 | 2 | 8 | 8 |

[∞]For antimicrobial abbreviations: see List of Abbreviations page 1

*R→ S & S → R (R, resistant; S, susceptible)

^S→R & R→S & S↔I or I↔R (I, intermediate)

• Data do not include one strain which may have lost resistance due to transport or storage stress

-, not determined

Table 9. Region-based categorization of EQAS participants' performance of *Salmonella* AST

| Region | EQAS iteration | No. of labs | % correct test result | % minor deviations (S ↔ I or I ↔ R)^ | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (S → R & R → S)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|----------------------------|----------------|-------------|-----------------------|--------------------------------------|-----------------------------|----------------------------------|--|--|---|
| Africa | 2001 | 7 | 80.1 | 9.6 | 7.7 | 2.5 | 10.2 | 19.8 | Cameroun, Egypt, Gambia (2), Ivory Coast, Kenya (4), Madagascar, Mauritius, Morocco, Nigeria (3), Senegal, South Africa, Sudan, Tunisia, Zambia |
| | 2002 | 10 | 94.3 | 4.1 | 1.0 | 0.6 | 1.6 | 5.7 | |
| | 2003 | 13 | 86.9 | 6.6 | 2.8 | 3.7 | 6.5 | 13.1 | |
| | 2004 | 11 | 85.7 | 7.2 | 5.2 | 1.9 | 7.1 | 14.3 | |
| | 2006 | 20 | 85.8 | 7.5 | 4.1 | 2.7 | 6.8 | 14.3 | |
| | 2007 | 16 | 90.7 | 4.4 | 4.0 | 0.9 | 4.9 | 9.3 | |
| | 2008 | 19 | 83.8 | 6.5 | 5.5 | 4.2 | 9.7 | 16.2 | |
| | 2009 | 22 | 90.1 | 4.5 | 3.6 | 1.8 | 5.4 | 9.9 | |
| | 2010 | 22 | 84.7 | 6.0 | 6.5 | 2.8 | 9.3 | 15.3 | |
| | 2011 | 17 | 87.0 | 5.0 | 4.7 | 3.3 | 8.0 | 13.0 | |
| | 2012 | 18 | 89.4 | 5.3 | 3.5 | 1.9 | 5.4 | 10.6 | |
| | 2013 | 16 | 92.0 | 3.2 | 4.0 | 0.9 | 4.9 | 8.0 | |
| | 2014 | 20 | 92.5 | 3.8 | 2.0 | 1.7 | 3.7 | 7.5 | |
| Central Asia & Middle East | 2001 | 10 | 87.7 | 6.3 | 5.2 | 0.8 | 6.0 | 12.3 | Bahrain, Georgia, India (9), Islamic rep. of Iran (3), Israel, Jordan, Kazakhstan |
| | 2002 | 6 | 83.4 | 9.8 | 6.6 | 0.2 | 6.8 | 16.6 | |
| | 2003 | 8 | 89.9 | 4.5 | 4.0 | 1.6 | 5.6 | 10.1 | |
| | 2004 | 10 | 87.5 | 6.7 | 5.5 | 0.3 | 5.8 | 12.5 | |
| | 2006 | 7 | 79.2 | 10.5 | 9.8 | 0.5 | 10.3 | 20.8 | |
| | 2007 | 8 | 87.8 | 5.0 | 6.2 | 1.1 | 7.3 | 12.2 | |
| | 2008 | 12 | 86.1 | 6.5 | 4.0 | 3.4 | 7.4 | 13.9 | |
| | 2009 | 6 | 93.7 | 4.3 | 0.9 | 1.1 | 2.0 | 6.3 | |
| | 2010 | 7 | 95.8 | 2.6 | 0.2 | 1.4 | 1.6 | 4.2 | |
| | 2011 | 4 | 91.8 | 4.1 | 1.8 | 2.3 | 4.1 | 8.2 | |
| | 2012 | 8 | 92.8 | 4.4 | 1.6 | 0.7 | 2.3 | 6.6 | |
| | 2013 | 8 | 93.6 | 5.2 | 1.0 | 0.1 | 1.2 | 6.4 | |
| | 2014 | 17 | 91.0 | 4.2 | 2.9 | 2.0 | 4.9 | 9.0 | |
| Caribbean | 2001 | 2 | 83.5 | 9.5 | 7.0 | 0.0 | 7.0 | 16.5 | Barbados, Cuba, Dominican Republic, Jamaica |
| | 2002 | 1 | 95.8 | 4.2 | 0.0 | 0.0 | 0.0 | 4.2 | |
| | 2003 | 8 | 91.7 | 6.4 | 1.5 | 0.5 | 2.0 | 8.4 | |
| | 2004 | 8 | 94.1 | 3.1 | 1.9 | 0.9 | 2.8 | 5.9 | |
| | 2006 | 5 | 92.1 | 5.4 | 1.6 | 1.0 | 2.6 | 8.0 | |
| | 2007 | 4 | 95.0 | 3.1 | 0.9 | 0.9 | 1.8 | 5.0 | |
| | 2008 | 5 | 90.7 | 5.5 | 0.9 | 2.9 | 3.8 | 9.3 | |
| | 2009 | 4 | 93.2 | 1.8 | 3.2 | 1.8 | 5.0 | 6.8 | |
| | 2010 | 4 | 90.9 | 5.4 | 2.7 | 0.7 | 3.4 | 8.8 | |
| | 2011 | 2 | 96.5 | 1.4 | 0.0 | 2.1 | 2.1 | 3.5 | |
| | 2012 | 4 | 91.1 | 1.5 | 6.7 | 0.7 | 7.4 | 8.9 | |
| | 2013 | 3 | 90.2 | 2.6 | 7.3 | 0.0 | 7.3 | 9.8 | |
| | 2014 | 4 | 78.3 | 4.7 | 9.4 | 7.6 | 17.0 | 21.7 | |

Table 9 (continued). Region-based categorization of EQAS participants' performance of *Salmonella* antimicrobial susceptibility testing

| Region | EQAS iteration | No. of labs | % correct test result | % minor deviations (S ↔ I or I ↔ R)^ | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (S → R & R → S)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|---------------|----------------|-------------|-----------------------|--------------------------------------|-----------------------------|----------------------------------|--|--|--|
| Europe | 2001 | 47 | 91.3 | 5.7 | 2.7 | 0.3 | 3.0 | 8.7 | Albania, Belgium, Bulgaria, Croatia (2), Cyprus, Denmark (2), France, Germany, Greece (3), Hungary, Ireland, Italy (10), Kosova, Luxembourg (2), Malta, Poland (3), Portugal, Serbia (2), Slovak Republic, Slovenia, Spain, Turkey, United Kingdom |
| | 2002 | 57 | 92.7 | 5.2 | 1.2 | 0.9 | 2.1 | 7.3 | |
| | 2003 | 64 | 92.9 | 3.8 | 1.0 | 2.3 | 3.3 | 7.1 | |
| | 2004 | 58 | 93.5 | 4.3 | 1.4 | 0.8 | 2.2 | 6.5 | |
| | 2006 | 54 | 88.7 | 7.0 | 3.8 | 0.6 | 4.4 | 11.3 | |
| | 2007 | 49 | 94.2 | 3.7 | 1.6 | 0.4 | 2.0 | 5.7 | |
| | 2008 | 51 | 91.2 | 4.4 | 2.5 | 1.9 | 4.4 | 8.8 | |
| | 2009 | 40 | 95.1 | 2.6 | 1.3 | 0.9 | 2.2 | 4.8 | |
| | 2010 | 39 | 92.4 | 4.1 | 1.2 | 2.3 | 3.5 | 7.6 | |
| | 2011 | 36 | 92.5 | 4.5 | 1.7 | 1.3 | 3.0 | 7.5 | |
| | 2012 | 40 | 95.5 | 2.8 | 1.2 | 0.4 | 1.7 | 4.5 | |
| | 2013 | 37 | 95.7 | 2.5 | 1.4 | 0.3 | 1.7 | 4.2 | |
| | 2014 | 40 | 96.6 | 2.1 | 0.8 | 0.5 | 1.3 | 3.4 | |
| North America | 2001 | 4 | 95.8 | 3.8 | 0.0 | 0.4 | 0.4 | 4.2 | Canada (4), USA (4) |
| | 2002 | 3 | 90.5 | 6.9 | 0.6 | 2.0 | 2.6 | 9.5 | |
| | 2003 | 7 | 93.4 | 5.2 | 0.0 | 1.4 | 1.4 | 6.6 | |
| | 2004 | 9 | 94.2 | 4.2 | 1.8 | 0.0 | 1.8 | 6.0 | |
| | 2006 | 8 | 94.8 | 2.9 | 1.0 | 1.3 | 2.3 | 5.2 | |
| | 2007 | 10 | 95.4 | 2.9 | 0.8 | 0.8 | 1.6 | 4.6 | |
| | 2008 | 14 | 96.4 | 0.6 | 0.4 | 2.6 | 3.0 | 3.6 | |
| | 2009 | 10 | 98.7 | 0.0 | 0.4 | 0.9 | 1.3 | 1.3 | |
| | 2010 | 11 | 94.8 | 2.6 | 0.2 | 2.4 | 2.6 | 5.2 | |
| | 2011 | 9 | 92.1 | 2.6 | 1.5 | 3.8 | 5.3 | 7.9 | |
| | 2012 | 10 | 96.0 | 2.1 | 1.0 | 0.9 | 1.9 | 4.0 | |
| | 2013 | 7 | 98.4 | 1.3 | 0.0 | 0.2 | 0.2 | 1.6 | |
| | 2014 | 8 | 96.9 | 2.2 | 0.4 | 0.6 | 0.9 | 3.1 | |
| Oceania | 2001 | 6 | 91.8 | 4.7 | 2.7 | 0.9 | 3.6 | 8.2 | Australia (3), New Zealand, Tuvalu |
| | 2002 | 7 | 91.7 | 6.2 | 0.0 | 2.0 | 2.0 | 8.3 | |
| | 2003 | 9 | 94.3 | 2.5 | 1.2 | 2.0 | 3.2 | 5.7 | |
| | 2004 | 11 | 97.1 | 2.5 | 0.3 | 0.1 | 0.4 | 2.9 | |
| | 2006 | 7 | 93.4 | 4.6 | 0.9 | 1.1 | 2.0 | 6.6 | |
| | 2007 | 1 | 98.9 | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | |
| | 2008 | 4 | 93.9 | 3.8 | 0.0 | 2.3 | 2.3 | 6.1 | |
| | 2009 | 4 | 95.9 | 3.2 | 0.3 | 0.6 | 0.9 | 4.1 | |
| | 2010 | 4 | 92.5 | 4.6 | 0.6 | 2.3 | 2.9 | 7.5 | |
| | 2011 | 4 | 93.8 | 5.6 | 0.6 | 0.0 | 0.6 | 6.2 | |
| | 2012 | 4 | 95.5 | 3.1 | 0.6 | 0.9 | 1.4 | 4.5 | |
| | 2013 | 4 | 96.8 | 2.9 | 0.0 | 0.3 | 0.3 | 3.2 | |
| | 2014 | 5 | 97.4 | 2.0 | 0.0 | 0.6 | 0.6 | 2.6 | |

Table 9 (continued). Region-based categorization of EQAS participants' performance of *Salmonella* antimicrobial susceptibility testing.

| Region | EQAS iteration | No. of labs | % correct test result | % minor deviations (S ↔ I or I ↔ R)^ | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (S → R & R → S)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|---------------|----------------|-------------|-----------------------|--------------------------------------|-----------------------------|----------------------------------|--|--|---|
| Russia | 2001 | 1 | 81.9 | 15.3 | 2.8 | 0.0 | 2.8 | 18.1 | Russia (4) |
| | 2002 | 1 | 84.5 | 9.9 | 5.6 | 0.0 | 5.6 | 15.5 | |
| | 2003 | 1 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| | 2004 | 4 | 91.2 | 6.6 | 1.5 | 0.7 | 2.2 | 8.8 | |
| | 2006 | 5 | 87.4 | 8.2 | 2.7 | 1.7 | 4.4 | 12.6 | |
| | 2007 | 8 | 88.9 | 5.8 | 4.8 | 0.4 | 5.2 | 11.0 | |
| | 2008 | 6 | 92.2 | 4.7 | 1.4 | 1.7 | 3.1 | 7.8 | |
| | 2009 | 6 | 93.8 | 2.1 | 3.3 | 0.8 | 4.1 | 6.2 | |
| | 2010 | 8 | 94.3 | 3.3 | 1.3 | 1.1 | 2.4 | 5.7 | |
| | 2011 | 7 | 90.0 | 4.8 | 3.2 | 2.0 | 5.2 | 10.0 | |
| | 2012 | 6 | 97.4 | 2.0 | 0.0 | 0.6 | 0.6 | 2.6 | |
| | 2013 | 2 | 98.2 | 1.8 | 0.0 | 0.0 | 0.0 | 1.8 | |
| | 2014 | 4 | 98.2 | 0.3 | 0.9 | 0.6 | 1.5 | 1.8 | |
| Latin America | 2001 | 11 | 90.8 | 6.9 | 1.4 | 1.0 | 2.4 | 9.2 | Argentina, Bolivia, Brazil (2), Chile (2), Colombia (2), Costa Rica, Ecuador (2), El Salvador, Guatemala, Honduras, Mexico (2), Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay (2), Venezuela |
| | 2002 | 13 | 93.7 | 4.6 | 0.7 | 1.0 | 1.7 | 6.3 | |
| | 2003 | 12 | 90.8 | 4.2 | 2.0 | 3.0 | 5.0 | 9.2 | |
| | 2004 | 17 | 94.4 | 4.7 | 0.8 | 0.1 | 0.9 | 5.6 | |
| | 2006 | 16 | 88.7 | 6.3 | 4.5 | 0.6 | 5.1 | 11.3 | |
| | 2007 | 17 | 94.9 | 1.8 | 1.9 | 1.4 | 3.3 | 5.0 | |
| | 2008 | 20 | 93.0 | 3.4 | 1.5 | 2.1 | 3.6 | 7.0 | |
| | 2009 | 20 | 95.6 | 2.1 | 1.1 | 1.2 | 2.3 | 4.4 | |
| | 2010 | 23 | 90.8 | 2.1 | 5.6 | 1.4 | 7.1 | 9.2 | |
| | 2011 | 22 | 90.8 | 2.8 | 3.1 | 3.3 | 6.4 | 9.2 | |
| | 2012 | 25 | 94.4 | 1.6 | 3.0 | 1.0 | 4.0 | 5.6 | |
| | 2013 | 25 | 95.5 | 2.6 | 1.2 | 0.3 | 1.5 | 4.2 | |
| | 2014 | 24 | 96.5 | 1.9 | 1.1 | 0.6 | 1.7 | 3.5 | |
| China | 2001 | 4 | 98.9 | 0.8 | 0.0 | 0.3 | 0.3 | 1.1 | Brunei Darussalam, Cambodia, Japan (2), LAO PDR, Malaysia (4), Philippines, Rep of Korea (2), Sri Lanka (2), Taiwan, Thailand (8), Viet Nam |
| | 2002 | 3 | 96.0 | 4.0 | 0.0 | 0.0 | 0.0 | 4.0 | |
| | 2003 | 8 | 90.1 | 3.6 | 2.8 | 3.6 | 6.4 | 10.0 | |
| | 2004 | 8 | 96.0 | 3.2 | 0.7 | 0.1 | 0.8 | 4.0 | |
| | 2006 | 6 | 89.6 | 7.0 | 2.9 | 0.5 | 3.4 | 10.4 | |
| | 2007 | 10 | 98.3 | 1.1 | 0.3 | 0.2 | 0.5 | 1.6 | |
| | 2008 | 18 | 92.8 | 3.7 | 0.8 | 2.7 | 3.5 | 7.2 | |
| | 2009 | 14 | 94.8 | 2.2 | 2.1 | 0.8 | 2.9 | 5.1 | |
| | 2010 | 9 | 92.1 | 4.5 | 1.6 | 1.8 | 3.4 | 7.9 | |
| | 2012 | 9 | 95.3 | 3.0 | 0.5 | 1.2 | 1.6 | 4.7 | |
| | 2013 | 8 | 96.9 | 2.0 | 0.5 | 0.5 | 1.0 | 3.1 | |
| | 2014 | 24 | 95.5 | 2.9 | 1.0 | 0.6 | 1.6 | 4.5 | |

^S. susceptible; I. intermediate; R. resistant

Table 9 (continued). Region-based categorization of EQAS participants' performance of *Salmonella* antimicrobial susceptibility testing.

| Region | EQAS iteration | No. of labs | % correct test result | % minor deviations (S ↔ I or I ↔ R)^ | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (S → R & R → S)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|----------------|----------------|-------------|-----------------------|--------------------------------------|-----------------------------|----------------------------------|--|--|---|
| Southeast Asia | 2001 | 16 | 88.1 | 7.7 | 2.3 | 1.9 | 4.2 | 11.9 | China (8) |
| | 2002 | 18 | 89.0 | 8.1 | 1.4 | 1.6 | 3.0 | 11.0 | |
| | 2003 | 17 | 87.4 | 5.2 | 4.7 | 2.7 | 7.4 | 12.6 | |
| | 2004 | 16 | 92.8 | 4.4 | 2.3 | 0.5 | 2.8 | 7.2 | |
| | 2006 | 15 | 90.0 | 8.1 | 1.2 | 0.8 | 2.0 | 10.0 | |
| | 2007 | 20 | 93.9 | 4.0 | 1.4 | 0.7 | 2.1 | 6.1 | |
| | 2008 | 19 | 90.5 | 4.7 | 2.2 | 2.6 | 4.8 | 9.5 | |
| | 2009 | 27 | 91.8 | 4.1 | 3.0 | 1.2 | 4.2 | 8.3 | |
| | 2010 | 25 | 92.8 | 3.8 | 1.5 | 1.9 | 3.4 | 7.2 | |
| | 2011 | 26 | 90.5 | 3.5 | 2.4 | 3.5 | 5.9 | 9.5 | |
| | 2012 | 35 | 91.7 | 3.9 | 3.5 | 0.9 | 4.4 | 8.3 | |
| | 2013 | 35 | 93.4 | 3.2 | 2.5 | 0.7 | 3.2 | 6.4 | |
| | 2014 | 8 | 97.0 | 1.2 | 0.1 | 1.6 | 1.8 | 3.0 | |

^S. susceptible; I. intermediate; R. resistant

Table 10. EQAS participants' performance of antimicrobial susceptibility testing of quality control strain *Escherichia coli* ATCC 25922

| | | Method | Performance ^{5,6} | AMC | AMP | CAZ | CHL | CIP | POD | CRO | CTX | ENR ² | FFN ² | FIS (SMX) ³ | GEN | NAL | STR | SXT | TET | TMP | XNL ² |
|--|------------|-------------|----------------------------|-------|-------|----------|-------|-------------|--------|-----------|-----------|------------------|------------------|------------------------|--------|-------|-------------------|----------|-------|-------|------------------|
| Accepted interval ¹ | | MIC (µg/ml) | | 2-8 | 2-8 | 0.06-0.5 | 2-8 | 0.004-0.016 | 0.25-1 | 0.03-0.12 | 0.03-0.12 | 0.008-0.03 | 2-8 | 8-32 | 0.25-1 | 1-4 | 4-16 ⁴ | ≤0.5/9.5 | 0.5-2 | 0.5-2 | 0.25-1 |
| | | Disks (mm) | | 18-24 | 16-22 | 25-32 | 21-27 | 30-40 | 23-28 | 29-35 | 29-35 | 32-40 | 22-28 | 15-23 | 19-26 | 22-28 | 12-20 | 23-29 | 18-25 | 21-28 | 26-31 |
| EQAS iteration (total no. of participants) | 2000 (44) | MIC & Disk | No. ⁵ | - | 37 | - | 38 | 35 | - | - | - | - | - | 19 | 39 | 37 | 36 | - | 42 | 31 | - |
| | | | % ⁶ | - | 27 | - | 37 | 20 | - | - | - | - | - | 53 | 23 | 35 | 22 | - | 42 | 30 | - |
| | 2001 (107) | MIC & Disk | No. ⁵ | - | 97 | - | 97 | 97 | - | - | - | - | - | 53 | 99 | 74 | 81 | 90 | 96 | 50 | - |
| | | | % ⁶ | - | 19 | - | 20 | 14 | - | - | - | - | - | 34 | 12 | 14 | 12 | 14 | 22 | 22 | - |
| | 2002 (114) | MIC & Disk | No. ⁵ | - | 109 | - | 107 | 108 | - | - | - | - | - | 57 | 108 | 102 | 82 | 102 | 102 | 66 | - |
| | | | % ⁶ | - | 16 | - | 15 | 14 | - | - | - | - | - | 26 | 12 | 14 | 11 | 12 | 13 | 11 | - |
| | 2003 (144) | MIC & Disk | No. ⁵ | - | 140 | - | 137 | 138 | - | - | - | - | - | 82 | 138 | 132 | 105 | 129 | 137 | 79 | - |
| | | | % ⁶ | - | 14 | - | 22 | 9 | - | - | - | - | - | 17 | 9 | 16 | 9 | 14 | 19 | 14 | - |
| | 2004 (140) | MIC & Disk | No. ⁵ | 117 | 132 | - | 128 | 132 | - | - | 111 | - | - | 84 | 134 | 126 | 110 | 120 | 129 | 87 | - |
| | | | % ⁶ | 13 | 10 | - | 13 | 8 | - | - | 18 | - | - | 16 | 10 | 9 | 6 | 11 | 13 | 9 | - |
| | 2006 (137) | MIC & Disk | No. ⁵ | 116 | 133 | 96 | 126 | 127 | 39 | - | 115 | 19 | - | 74 | 131 | 122 | 106 | 122 | 125 | 74 | 32 |
| | | | % ⁶ | 9 | 14 | 15 | 18 | 8 | 12 | - | 21 | 63 | - | 29 | 14 | 20 | 11 | 19 | 12 | 17 | 22 |
| | 2007 (126) | MIC & Disk | No. ⁵ | 102 | 124 | 92 | 123 | 121 | 47 | - | 104 | - | 13 | 64 | 124 | 120 | 97 | 107 | 117 | 67 | 35 |
| | | | % ⁶ | 8 | 11 | 9 | 14 | 12 | 9 | - | 16 | - | 0 | 22 | 6 | 7 | 6 | 13 | 7 | 10 | 11 |
| | 2008 (147) | MIC & Disk | No. ⁵ | - | 147 | 111 | 135 | 144 | - | - | 124 | - | - | 71 | 145 | 136 | 101 | 129 | 139 | 79 | - |
| | | | % ⁶ | - | 12 | 9 | 10 | 8 | - | - | 14 | - | - | 14 | 8 | 8 | 12 | 13 | 7 | 13 | - |
| | | MIC | No. ⁵ | - | 33 | 23 | 24 | 33 | - | - | 23 | - | - | 18 | 31 | 23 | 19 | 22 | 28 | 16 | - |
| | | | % ⁶ | - | 0 | 5 | 0 | 6 | - | - | 9 | - | - | 11 | 0 | 0 | 11 | 9 | 0 | 13 | - |
| | | Disk | No. ⁵ | - | 114 | 89 | 112 | 111 | - | - | 101 | - | - | 53 | 114 | 113 | 82 | 107 | 111 | 63 | - |
| | | | % ⁶ | - | 16 | 10 | 12 | 8 | - | - | 15 | - | - | 15 | 11 | 10 | 12 | 14 | 9 | 13 | - |
| | 2009 (129) | MIC & Disk | No. ⁵ | - | 128 | 100 | 121 | 124 | - | 88 | 107 | - | - | 63 | 123 | 117 | 98 | 113 | 122 | 70 | - |
| | | | % ⁶ | - | 16 | 13 | 15 | 7 | - | 16 | 10 | - | - | 11 | 18 | 13 | 10 | 14 | 14 | 11 | - |
| | | MIC (27) | No. ⁵ | - | 27 | 19 | 24 | 26 | - | 20 | 20 | - | - | 14 | 25 | 24 | 19 | 21 | 27 | 25 | - |
| | | | % ⁶ | - | 11 | 11 | 8 | 8 | - | 15 | 15 | - | - | 21 | 12 | 8 | 5 | 19 | 11 | 13 | - |
| | | Disk (102) | No. ⁵ | - | 101 | 81 | 97 | 98 | - | 68 | 87 | - | - | 49 | 98 | 93 | 79 | 92 | 95 | 55 | - |
| | | | % ⁶ | - | 16 | 14 | 16 | 6 | - | 16 | 9 | - | - | 10 | 18 | 14 | 11 | 12 | 15 | 11 | - |
| | 2010 (116) | MIC & Disk | No. ⁵ | - | 114 | 97 | 108 | 115 | - | 79 | 100 | - | - | 51 | 112 | 104 | 84 | 101 | 110 | 63 | - |
| | | | % ⁶ | - | 11 | 9 | 9 | 6 | - | 10 | 14 | - | - | 11 | 11 | 5 | 5 | 12 | 5 | 15 | - |
| | | MIC (25) | No. ⁵ | - | 25 | 15 | 21 | 25 | - | 15 | 17 | - | - | 12 | 24 | 19 | 17 | 17 | 24 | 11 | - |
| | | | % ⁶ | - | 12 | 20 | 10 | 8 | - | 7 | 18 | - | - | 8 | 13 | 16 | 18 | 18 | 17 | 36 | - |
| | | Disk (91) | No. ⁵ | - | 89 | 82 | 87 | 90 | - | 64 | 83 | - | - | 39 | 88 | 85 | 67 | 84 | 86 | 52 | - |
| | | | % ⁶ | - | 9 | 6 | 8 | 4 | - | 9 | 11 | - | - | 10 | 9 | 2 | 1 | 10 | 1 | 8 | - |

Table 10 (continued). EQAS participants' performance of antimicrobial susceptibility testing of quality control strain *Escherichia coli* ATCC 25922

| | | Method | Performance ^{5,6} | AMC | AMP | CAZ | CHL | CIP | POD | CRO | CTX | ENR ² | FFN ² | FIS (SMX) ³ | GEN | NAL | STR | SXT | TET | TMP | XNL ² |
|--|------------|-------------|----------------------------|-------|-------|----------|-------|-------------|--------|-----------|-----------|------------------|------------------|------------------------|--------|-------|-------------------|----------|-------|-------|------------------|
| Accepted interval ¹ | | MIC (µg/ml) | | 2-8 | 2-8 | 0.06-0.5 | 2-8 | 0.004-0.016 | 0.25-1 | 0.03-0.12 | 0.03-0.12 | 0.008-0.03 | 2-8 | 8-32 | 0.25-1 | 1-4 | 4-16 ⁴ | ≤0.5/9.5 | 0.5-2 | 0.5-2 | 0.25-1 |
| | | Disks (mm) | | 18-24 | 16-22 | 25-32 | 21-27 | 30-40 | 23-28 | 29-35 | 29-35 | 32-40 | 22-28 | 15-23 | 19-26 | 22-28 | 12-20 | 23-29 | 18-25 | 21-28 | 26-31 |
| EQAS iteration (total no. of participants) | 2011 (112) | MIC & Disk | No. ⁵ | - | 111 | 89 | 102 | 109 | - | 76 | 96 | - | - | 50 | 103 | 103 | 72 | 99 | 107 | 51 | - |
| | | | % ⁶ | - | 17 | 4 | 11 | 7 | - | 7 | 9 | - | - | 8 | 11 | 8 | 4 | 16 | 7 | 14 | - |
| | | MIC (23) | No. ⁵ | - | 23 | 15 | 18 | 22 | - | 16 | 15 | - | - | 13 | 22 | 19 | 17 | 16 | 21 | 11 | - |
| | | | % ⁶ | - | 4 | 7 | 0 | 9 | - | 6 | 0 | - | - | 8 | 9 | 0 | 6 | 6 | 5 | 0 | - |
| | | Disk (89) | No. ⁵ | - | 88 | 74 | 84 | 87 | - | 60 | 81 | - | - | 37 | 81 | 84 | 55 | 83 | 86 | 40 | - |
| | | | % ⁶ | - | 20 | 4 | 13 | 7 | - | 7 | 11 | - | - | 8 | 11 | 10 | 4 | 18 | 8 | 18 | - |
| | 2012 (135) | MIC & Disk | No. ⁵ | - | 134 | 111 | 121 | 131 | - | 90 | 115 | - | - | 53 | 127 | 121 | 89 | 112 | 129 | 66 | - |
| | | | % ⁶ | - | 13 | 12 | 7 | 6 | - | 11 | 10 | - | - | 11 | 9 | 9 | 8 | 13 | 10 | 21 | - |
| | | MIC (37) | No. ⁵ | - | 37 | 26 | 31 | 35 | - | 23 | 28 | - | - | 19 | 35 | 31 | 26 | 23 | 35 | 22 | - |
| | | | % ⁶ | - | 3 | 4 | 0 | 3 | - | 0 | 4 | - | - | 5 | 3 | 3 | 8 | 0 | 0 | 9 | - |
| | | Disk (98) | No. ⁵ | - | 97 | 85 | 90 | 96 | - | 67 | 87 | - | - | 34 | 92 | 90 | 63 | 89 | 94 | 44 | - |
| | | | % ⁶ | - | 16 | 14 | 9 | 7 | - | 15 | 11 | - | - | 15 | 11 | 11 | 8 | 16 | 14 | 27 | - |
| | 2013 (122) | MIC & Disk | No. ⁵ | - | 117 | 100 | 112 | 119 | - | 82 | 107 | - | - | 44 | 113 | 113 | - | 101 | 114 | 59 | - |
| | | | % ⁶ | - | 12 | 7 | 5 | 7 | - | 4 | 8 | - | - | 10 | 6 | 11 | - | 8 | 8 | 11 | - |
| | | MIC (33) | No. ⁵ | - | 31 | 25 | 28 | 32 | - | 19 | 27 | - | - | 17 | 32 | 28 | - | 22 | 32 | 22 | - |
| | | | % ⁶ | - | 6 | 4 | 4 | 13 | - | 5 | 11 | - | - | 18 | 9 | 11 | - | 5 | 6 | 5 | - |
| | | Disk (89) | No. ⁵ | - | 86 | 75 | 84 | 87 | - | 63 | 80 | - | - | 27 | 81 | 85 | - | 79 | 82 | 37 | - |
| | | | % ⁶ | - | 13 | 8 | 6 | 5 | - | 5 | 6 | - | - | 7 | 4 | 9 | - | 10 | 7 | 8 | - |
| | 2014 (115) | MIC & Disk | No. ⁵ | - | 111 | 99 | 101 | 108 | - | 75 | 97 | - | - | 49 | 111 | 103 | - | 102 | 104 | 50 | - |
| | | | % ⁶ | - | 5 | 7 | 7 | 6 | - | 7 | 14 | - | - | 14 | 8 | 8 | - | 8 | 7 | 2 | - |
| | | MIC (28) | No. ⁵ | - | 27 | 21 | 24 | 27 | - | 16 | 22 | - | - | 16 | 28 | 24 | - | 21 | 25 | 12 | - |
| | | | % ⁶ | - | 4 | 5 | 4 | 15 | - | 6 | 14 | - | - | 0 | 14 | 8 | - | 14 | 0 | 0 | - |
| | | Disk (87) | No. ⁵ | - | 84 | 78 | 77 | 81 | - | 59 | 75 | - | - | 33 | 83 | 79 | - | 81 | 79 | 38 | - |
| | | | % ⁶ | - | 6 | 8 | 8 | 4 | - | 7 | 15 | - | - | 21 | 6 | 8 | - | 6 | 9 | 3 | - |

⁰For antimicrobial abbreviations: see List of Abbreviations page 1¹CLSI standard. Performance Standards for Antimicrobial Disk and Dilution Susceptibility testing. 22nd Informational supplement. CLSI document M100-S22. 2012 Wayne. PA. USA²CLSI standard. Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for bacteria Isolated from Animals. M31-A3. 3rd Edition [Approved Standard]. 2008. Wayne. PA. USA³FIS (sulfisoxazole) covers the group of SMX (sulfonamides)⁴Quality control range developed by the manufacturer of Sensititre®⁵No.. number of laboratories performing the analysis⁶%. percentage of laboratories reporting erroneous results

-, not determined

Table 11. *Shigella* serotypes (ST) and deviations (D). WHO EQAS 2014

| Strain | Correct serotype | | No. of labs reporting correct identification | D (%) | Deviating results | No. of labs reporting correct ST | D (%) | Deviating results (*) |
|-------------------------|--------------------|--------|--|-------|-------------------|----------------------------------|-------|-----------------------|
| WHO 2014 SH-14.1 | <i>S. sonnei</i> | N/A | 120 | 3,2 | 4 | NA | NA | NA |
| WHO 2014 SH-14.2 | <i>S. sonnei</i> | N/A | 116 | 4,1 | 5 | NA | NA | NA |
| WHO 2014 SH-14.3 | <i>S. flexneri</i> | 2 / 2b | 122 | 2,4 | 3 | 67 | 16,3 | 2a(9), var. X(4) |
| WHO 2014 SH-14.4 | <i>S. boydii</i> | 2 | 117 | 5,6 | 7 | 64 | 7,2 | 1(2), 3, 5, 11 |

*number of participants reporting deviating result

Table 12. Region-based categorization of laboratories performing *Shigella* serotyping in 2014

| Region | Year | No. of laboratories | No. of strains serotyped | Strains serotyped correctly (%) | Countries participating in the 2014 iteration |
|----------------------------|------|---------------------|--------------------------|---------------------------------|--|
| Africa | 2009 | 8 | 18 | 72.2 | Egypt, Ivory Coast, Kenya, Mauritius, South Africa, Tunisia, |
| | 2010 | 7 | 16 | 62.5 | |
| | 2011 | 4 | 10 | 100.0 | |
| | 2012 | 5 | 18 | 90.0 | |
| | 2013 | 5 | 8 | 62.5 | |
| | 2014 | 6 | 12 | 58.3 | |
| Central Asia & Middle East | 2009 | 3 | 5 | 100.0 | Bahrain, India (2), Iran (Islamic rep. of), Israel, Jordan |
| | 2010 | 3 | 6 | 83.3 | |
| | 2011 | 2 | 6 | 100.0 | |
| | 2012 | 3 | 9 | 81.8 | |
| | 2013 | 4 | 8 | 100.0 | |
| | 2014 | 8 | 20 | 85.0 | |
| China | 2009 | 13 | 35 | 100.0 | China (9) |
| | 2010 | 9 | 23 | 91.3 | |
| | 2011 | - | - | - | |
| | 2012 | 8 | 29 | 90.6 | |
| | 2013 | 6 | 11 | 100.0 | |
| | 2014 | 9 | 33 | 93.9 | |
| Caribbean | 2009 | - | - | - | Barbados, Jamaica |
| | 2010 | - | - | - | |
| | 2011 | - | - | - | |
| | 2012 | 1 | 1 | 33.3 | |
| | 2013 | - | - | - | |
| | 2014 | 2 | 3 | 66.7 | |
| Europe | 2009 | 15 | 40 | 92.5 | Albania, Belgium, Bulgaria, Czech Republic, Denmark, Germany (2), Greece, Ireland, Italy (2), Luxembourg, Malta, Poland, Portugal, Serbia (2), Slovenia (2), Spain, Sweden, Turkey, United Kingdom |
| | 2010 | 15 | 35 | 85.7 | |
| | 2011 | 16 | 42 | 92.9 | |
| | 2012 | 19 | 63 | 86.3 | |
| | 2013 | 18 | 31 | 96.8 | |
| | 2014 | 23 | 58 | 84.5 | |
| North America | 2009 | 7 | 18 | 100.0 | Canada (7), USA |
| | 2010 | 7 | 20 | 100.0 | |
| | 2011 | 6 | 16 | 100.0 | |
| | 2012 | 8 | 25 | 80.6 | |
| | 2013 | 8 | 14 | 100.0 | |
| | 2014 | 8 | 24 | 95.8 | |

Table 12 (continued). Region-based categorization of laboratories performing *Shigella* serotyping in 2014

| Region | Year | No. of laboratories | No. of strains serotyped | Strains serotyped correctly (%) | Countries participating in the 2014 iteration |
|----------------|------|---------------------|--------------------------|---------------------------------|---|
| Oceanic | 2009 | 3 | 8 | 100.0 | Australia (3), New Zealand |
| | 2010 | 3 | 8 | 100.0 | |
| | 2011 | 3 | 8 | 100.0 | |
| | 2012 | 3 | 12 | 100.0 | |
| | 2013 | 4 | 10 | 100.0 | |
| | 2014 | 4 | 13 | 100.0 | |
| Russia | 2009 | 6 | 18 | 83.3 | Russia (3) |
| | 2010 | 7 | 20 | 75.0 | |
| | 2011 | 6 | 18 | 88.9 | |
| | 2012 | 5 | 16 | 80.0 | |
| | 2013 | 2 | 4 | 100.0 | |
| | 2014 | 3 | 10 | 100.0 | |
| Latin America | 2009 | 16 | 40 | 97.5 | Argentina, Brazil (2), Chile (2), Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico (2), Nicaragua, Panama, Paraguay, Peru, Uruguay, Venezuela |
| | 2010 | 13 | 33 | 78.8 | |
| | 2011 | 15 | 37 | 94.6 | |
| | 2012 | 19 | 58 | 80.6 | |
| | 2013 | 16 | 30 | 93.3 | |
| | 2014 | 18 | 54 | 87.0 | |
| Southeast Asia | 2009 | 11 | 30 | 90.0 | Japan (2), LAO PDR, Malaysia, Philippines, Rep of Korea, Sri Lanka, Taiwan, Thailand (4) |
| | 2010 | 14 | 32 | 87.5 | |
| | 2011 | 13 | 33 | 84.8 | |
| | 2012 | 14 | 47 | 90.4 | |
| | 2013 | 9 | 17 | 100.0 | |
| | 2014 | 12 | 30 | 83.3 | |

Table 13. EQAS participating laboratories' performance of *Shigella* strains antimicrobial susceptibility testing

| EQAS iteration | No. of participating laboratories | % correct test results | % minor deviations (S ↔ I or I ↔ R) [^] | % major deviations (S → R) [^] | % very major deviations (R → S) [^] | % critical deviations (S → R & R → S) [^] | % total deviations (S → R & R → S & S ↔ I or I ↔ R) [^] |
|----------------|-----------------------------------|------------------------|---|--|---|---|---|
| 2008 | 15 | 95 | 2 | 2 | 1 | 3 | 5 |
| 2009 | 111 | 96 | 2 | 1 | 1 | 2 | 4 |
| 2010 | 114 | 91 | 2 | 1 | 6 | 7 | 9 |
| 2011 | 107 | 92 | 2 | 1 | 4 | 5 | 7 |
| 2012 | 120 | 91 | 3 | 1 | 5 | 6 | 9 |
| 2013 | 99 | 91 | 6 | 2 | 2 | 4 | 10 |
| 2014 | 116 | 92 | 4 | 1 | 3 | 4 | 8 |

[^]S. susceptible; I. intermediate; R. resistant

Table 14. Antimicrobial susceptibility test results (number of R/I/S) for the EQAS 2014 *Shigella* strains*

| Strain | Antimicrobial [∞] | | | | | | | | | | | |
|-------------|----------------------------|--------|----------|--------|--------|----------|---------|---------|--------|--------|---------|--------|
| | AMP | CTX | CAZ | CRO | CHL | CIP | GEN | NAL | SMX | TET | SXT | TMP |
| WHO SH-14.1 | 109/0/1 | 98/0/0 | 80/6/12 | 82/1/1 | 0/0/96 | 9/56/46 | 6/1/100 | 89/10/1 | 47/0/0 | 95/3/2 | 103/0/2 | 45/0/2 |
| WHO SH-14.2 | 106/1/3 | 94/0/2 | 68/10/20 | 77/3/1 | 1/0/97 | 0/6/106 | 95/4/6 | 4/0/99 | 46/0/1 | 96/2/1 | 100/0/3 | 47/0/1 |
| WHO SH-14.3 | 106/1/3 | 0/1/96 | 3/0/93 | 3/0/80 | 83/7/6 | 23/52/35 | 3/0/104 | 98/0/2 | 44/0/3 | 92/2/5 | 99/0/4 | 44/1/4 |
| WHO SH-14.4 | 107/0/4 | 3/0/95 | 3/1/94 | 1/0/82 | 1/0/95 | 0/3/105 | 2/1/102 | 3/1/98 | 42/0/5 | 89/5/6 | 7/1/94 | 3/1/41 |

[∞]For antimicrobial abbreviations: see List of Abbreviations page 1

*In bold: expected interpretation. Grey cell: <90% of laboratories did correct interpretation. R. resistant; I. intermediate; S. susceptible.

Table 15. EQAS laboratories' performance of *Shigella* strains antimicrobial susceptibility testing categorized by antimicrobial

| EQAS iteration | No. of labs | Lab performance | Antimicrobial | | | | | | | | | | | | | |
|----------------|-------------|------------------------|---------------|------|------|------|-----|-----|------|-----|------|------|-----|-----|-----|---------|
| | | | AMP | CAZ | CHL | CIP | CTX | GEN | NAL | SMX | STR | SXT | TET | TMP | CRO | OVERALL |
| 2008 | 15 | No. of tests | 52 | 44 | 51 | 48 | 48 | 50 | 52 | 7 | 27 | 52 | 52 | 4 | 42 | 529 |
| | | % critical deviations* | 1 | 2 | 1 | - | 2 | 1 | - | - | 4 | 2 | 4 | - | 2 | 1.5 |
| | | % total deviations^ | 1 | 2 | 1 | - | 2 | 1 | - | - | 9 | 2 | 8 | - | 2 | 2.2 |
| 2009 | 111 | No. of tests | 423 | 358 | 388 | 426 | 372 | 396 | 388 | 211 | 293 | 388 | 386 | 218 | 301 | 4.548 |
| | | % critical deviations* | 2.4 | 0.3 | 2.1 | 0.2 | 1.1 | 2.5 | 0.5 | 3.8 | 5.8 | 2.3 | 2.8 | 1.8 | 0.3 | 1.9 |
| | | % total deviations^ | 3.8 | 0.3 | 4.6 | 0.9 | 1.1 | 3.5 | 1.5 | 3.8 | 18.1 | 3.6 | 7.5 | 1.8 | 0.6 | 3.8 |
| 2010 | 114 | No. of tests | 424 | 344 | 402 | 434 | 377 | 403 | 382 | 194 | 275 | 363 | 410 | 218 | 291 | 4.517 |
| | | % critical deviations* | 1.7 | 0.6 | 3.5 | 40.8 | 2.4 | 3.5 | 2.1 | 4.6 | 8.0 | 8.3 | 4.4 | 3.7 | 0.0 | 6.4 |
| | | % total deviations^ | 1.9 | 1.2 | 9.2 | 77.9 | 3.0 | 5.5 | 3.0 | 6.0 | 14.6 | 13.8 | 5.9 | 3.8 | 0.0 | 11.2 |
| 2011 | 107 | No. of tests | 403 | 322 | 353 | 396 | 343 | 359 | 369 | 179 | 246 | 371 | 376 | 178 | 289 | 4.184 |
| | | % critical deviations* | 5.5 | 5.2 | 2.2 | 38.9 | 2.7 | 3.3 | 4.0 | 1.7 | 3.6 | 3.2 | 2.7 | 2.2 | 2.0 | 5.5 |
| | | % total deviations^ | 7.7 | 12.0 | 4.2 | 40.7 | 2.7 | 4.4 | 11.0 | 1.7 | 10.5 | 3.2 | 3.5 | 2.2 | 2.0 | 7.7 |
| 2012 | 120 | No. of tests | 462 | 376 | 427 | 464 | 400 | 430 | 442 | 196 | 291 | 396 | 426 | 215 | 337 | 4.862 |
| | | % critical deviations* | 2.6 | 0.8 | 5.6 | 35.3 | 2.0 | 4.9 | 1.6 | 1.5 | 9.3 | 6.3 | 5.4 | 1.9 | 0.9 | 6.0 |
| | | % total deviations^ | 3.9 | 0.8 | 11.5 | 38.6 | 3.8 | 6.3 | 3.2 | 2.0 | 27.1 | 8.1 | 7.5 | 4.2 | 2.1 | 9.2 |
| 2013 | 99 | No. of tests | - | 351 | 379 | 420 | 384 | 392 | 393 | 164 | - | 346 | 392 | 193 | 309 | 3723 |
| | | % critical deviations* | - | 1.1 | 2.1 | 8.3 | 3.4 | 2.3 | 3.3 | 1.8 | - | 5.8 | 2.8 | 3.1 | 1.0 | 3.4 |
| | | % total deviations^ | - | 0.3 | 0.6 | 2.0 | 0.9 | 0.6 | 0.8 | 1.1 | - | 1.7 | 0.7 | 1.6 | 0.3 | 9.5 |
| 2014 | 116 | No. of tests | 441 | 390 | 386 | 441 | 389 | 424 | 405 | 188 | - | 413 | 398 | 189 | 331 | 4395 |
| | | % critical deviations* | 2.5 | 9.7 | 2.1 | 7.9 | 1.3 | 4.0 | 2.5 | 4.8 | - | 3.9 | 3.5 | 5.3 | 2.1 | 4.1 |
| | | % total deviations^ | 2.9 | 14.1 | 3.9 | 34.2 | 1.5 | 5.4 | 5.2 | 4.8 | - | 4.1 | 6.5 | 6.3 | 3.9 | 8.1 |

∞For antimicrobial abbreviations: see List of Abbreviations page 1

*R→ S & S → R (R. resistant; S. susceptible)

^S→R & R→S & S↔I or I↔R (I. intermediate)

-. not determined

Table 16. Region-based categorization of EQAS participating laboratories' performance of antimicrobial susceptibility tests for *Shigella* strains

| Region | Year | No. of labs | % correct test result | % minor deviations ($S \leftrightarrow I$ or $I \leftrightarrow R$) [^] | % major deviations ($S \rightarrow R$) [^] | % very major deviations ($R \rightarrow S$) [^] | % critical deviations ($R \rightarrow S$ & $S \rightarrow R$) [^] | % total deviations ($S \rightarrow R$ & $R \rightarrow S$ & $S \leftrightarrow I$ or $I \leftrightarrow R$) [^] | Countries participating in the 2014 iteration |
|----------------------------|------|-------------|-----------------------|---|--|---|---|---|---|
| Africa | 2009 | 17 | 93.3 | 2.4 | 3.5 | 0.8 | 4.3 | 6.8 | Cameroun, Egypt, Gambia (2), Ivory Coast, Kenya (4), Madagascar, Mauritius, Nigeria (2), Senegal, South Africa, Sudan, Tunisia, Zambia |
| | 2010 | 16 | 84.8 | 2.5 | 2.7 | 10.0 | 12.7 | 15.2 | |
| | 2011 | 16 | 86.0 | 1.8 | 3.6 | 8.3 | 11.9 | 13.7 | |
| | 2012 | 17 | 82.6 | 4.2 | 2.5 | 10.7 | 13.2 | 17.4 | |
| | 2013 | 14 | 87,6 | 7,2 | 2,5 | 2,7 | 5,2 | 12,4 | |
| | 2014 | 18 | 85.3 | 6.1 | 2.3 | 6.4 | 8.7 | 14.7 | |
| Central Asia & Middle East | 2009 | 5 | 94.8 | 0.9 | 3.0 | 1.3 | 4.4 | 5.2 | Bahrain, Georgia, India (9), Islamic rep. of Iran (3), Israel, Jordan |
| | 2010 | 6 | 90.6 | 1.2 | 1.6 | 6.7 | 8.3 | 9.4 | |
| | 2011 | 4 | 92.9 | 1.6 | 0.5 | 4.9 | 5.4 | 7.1 | |
| | 2012 | 6 | 92.3 | 4.0 | 2.0 | 1.3 | 3.4 | 7.4 | |
| | 2013 | 6 | 86,9 | 8,5 | 3,9 | 0,8 | 4,6 | 13,1 | |
| | 2014 | 16 | 85.6 | 6.7 | 1.7 | 6.0 | 7.7 | 14.4 | |
| Caribbean | 2009 | 4 | 95.6 | 1.5 | 0.7 | 2.2 | 2.9 | 4.4 | Barbados, Dominican Republic, Jamaica |
| | 2010 | 4 | 88.5 | 1.5 | 3.8 | 6.2 | 10.0 | 11.5 | |
| | 2011 | 1 | 97.7 | 2.3 | 0.0 | 0.0 | 2.3 | 2.3 | |
| | 2012 | 3 | 84.6 | 1.9 | 7.7 | 5.8 | 13.5 | 15.4 | |
| | 2013 | 2 | 87,5 | 9,4 | 0,0 | 3,1 | 3,1 | 12,5 | |
| | 2014 | 3 | 76.5 | 5.1 | 7.1 | 11.2 | 18.4 | 23.5 | |
| Europe | 2009 | 22 | 98.1 | 1.1 | 0.7 | 0.1 | 0.8 | 1.9 | Albania, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Germany, Greece (2), Ireland, Italy (6), Luxembourg, Malta, Poland (2), Serbia (2), Slovenia, Spain, Turkey, United Kingdom |
| | 2010 | 27 | 93.6 | 1.5 | 0.9 | 3.9 | 4.8 | 6.4 | |
| | 2011 | 24 | 94.8 | 2.2 | 0.5 | 2.5 | 3.0 | 5.1 | |
| | 2012 | 24 | 96.6 | 1.7 | 0.4 | 1.4 | 1.7 | 3.4 | |
| | 2013 | 23 | 93,6 | 4,8 | 1,2 | 0,3 | 1,5 | 6,4 | |
| | 2014 | 26 | 96.0 | 3.2 | 0.1 | 0.7 | 0.8 | 4.0 | |

Table 16 (continued) Region-based categorization of EQAS participating laboratories' performance of antimicrobial susceptibility tests for *Shigella* strains

| Region | Year | No. of labs | % correct test result | % minor deviations (S↔I or I↔R)^ | % major deviations (S→R)^ | % very major deviations (R→S)^ | % critical deviations (R→S & S→R)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|---------------|------|-------------|-----------------------|----------------------------------|---------------------------|--------------------------------|------------------------------------|--|---|
| North America | 2009 | 6 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Canada (2), USA |
| | 2010 | 7 | 95.0 | 0.0 | 0.0 | 5.0 | 5.0 | 5.0 | |
| | 2011 | 4 | 90.1 | 0.7 | 3.3 | 5.9 | 9.2 | 9.9 | |
| | 2012 | 6 | 89.5 | 0.0 | 2.1 | 8.4 | 10.5 | 10.5 | |
| | 2013 | 4 | 95.2 | 3.2 | 0.0 | 1.6 | 1.6 | 4.8 | |
| | 2014 | 3 | 95.4 | 2.8 | 0.0 | 1.9 | 1.9 | 4.6 | |
| Oceanic | 2009 | - | - | - | - | - | - | - | Australia, Tuvalu |
| | 2010 | 1 | 90.0 | 10.0 | 0.0 | 0.0 | 0.0 | 10.0 | |
| | 2011 | 1 | 92.5 | 5.0 | 0.0 | 2.5 | 2.5 | 7.5 | |
| | 2012 | 1 | 90.0 | 7.5 | 0.0 | 2.5 | 2.5 | 10.0 | |
| | 2013 | 1 | 95.5 | 4.5 | 0.0 | 0.0 | 0.0 | 4.5 | |
| | 2014 | 2 | 96.2 | 3.8 | 0.0 | 0.0 | 0.0 | 3.8 | |
| Russia | 2009 | 6 | 95.5 | 1.6 | 1.6 | 1.3 | 2.9 | 4.6 | Russia (3) |
| | 2010 | 7 | 92.1 | 2.9 | 1.5 | 3.5 | 5.0 | 7.9 | |
| | 2011 | 6 | 94.4 | 3.6 | 0.0 | 2.0 | 2.0 | 5.6 | |
| | 2012 | 5 | 96.8 | 1.4 | 0.5 | 1.4 | 1.8 | 3.2 | |
| | 2013 | 2 | 95.2 | 4.8 | 0.0 | 0.0 | 0.0 | 4.8 | |
| | 2014 | 3 | 98.4 | 0.8 | 0.0 | 0.8 | 0.8 | 1.6 | |
| Latin America | 2009 | 20 | 98.3 | 1.1 | 0.4 | 0.3 | 0.7 | 1.7 | Argentina, Bolivia, Brazil (2), Chile (2), Colombia, Costa Rica, Ecuador (2), El Salvador, Guatemala, Honduras, Mexico (2), Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay (2), Venezuela |
| | 2010 | 22 | 92.1 | 1.3 | 2.1 | 4.5 | 6.6 | 7.9 | |
| | 2011 | 20 | 94.0 | 1.5 | 1.3 | 3.2 | 4.5 | 6.0 | |
| | 2012 | 24 | 91.7 | 1.3 | 0.6 | 6.5 | 7.1 | 8.3 | |
| | 2013 | 23 | 94.1 | 3.9 | 1.2 | 0.8 | 2.0 | 5.9 | |
| | 2014 | 23 | 94.4 | 3.3 | 0.5 | 1.9 | 2.3 | 5.6 | |

^S. susceptible; I. intermediate; R. resistant.

Table 16 (continued) Region-based categorization of EQAS participating laboratories' performance of antimicrobial susceptibility tests for *Shigella* strains

| Region | Year | No. of labs | % correct test result | % minor deviations (S↔I or I↔R)^ | % major deviations (S→R)^ | % very major deviations (R→S)^ | % critical deviations (R→S & S→R)^ | % total deviations (S→R & R→S & S↔I or I↔R)^ | Countries participating in the 2014 iteration |
|----------------|------|-------------|-----------------------|-------------------------------------|------------------------------|-----------------------------------|---------------------------------------|---|--|
| Southeast Asia | 2009 | 18 | 94.1 | 3.9 | 0.3 | 1.7 | 2.0 | 5.9 | Cambodia, Japan (2), LAO PDR, Malaysia, Philippines, Rep of Korea, Sri Lanka, Taiwan, Thailand (3), Viet Nam |
| | 2010 | 16 | 90.5 | 2.4 | 0.7 | 6.4 | 7.1 | 9.5 | |
| | 2011 | 19 | 90.0 | 2.1 | 0.8 | 6.1 | 6.9 | 9.0 | |
| | 2012 | 27 | 87.1 | 5.1 | 1.9 | 5.6 | 7.6 | 12.7 | |
| | 2013 | 19 | 86.2 | 7.5 | 2.9 | 3.1 | 6.0 | 13.5 | |
| | 2014 | 13 | 92.5 | 4.0 | 1.1 | 2.4 | 3.5 | 7.5 | |
| China | 2009 | 12 | 96.3 | 2.2 | 1.0 | 0.5 | 1.5 | 3.7 | China (8) |
| | 2010 | 8 | 92.7 | 1.2 | 0.6 | 5.5 | 6.1 | 7.3 | |
| | 2011 | - | - | - | - | - | - | - | |
| | 2012 | 7 | 90.3 | 2.9 | 0.0 | 6.8 | 6.8 | 9.7 | |
| | 2013 | 5 | 92.7 | 3.4 | 0.4 | 3.4 | 3.9 | 7.3 | |
| | 2014 | 8 | 94.6 | 2.2 | 0.3 | 3.0 | 3.2 | 5.4 | |

^S. susceptible; I. intermediate; R. resistant.

Table 17. Proportion of laboratories that obtained the expected result. Number (n/N) and percentages of laboratories which correctly detected and confirmed the ESBL and non ESBL producing *Salmonella* and *Shigella* strains.

| Isolate no. | Expected interpretation | Confirmatory tests | |
|------------------|-------------------------|--------------------|--------------|
| | | CAZ/CI:CAZ | CTX/CI:CTX |
| WHO 2014 S-14.1 | non ESBL | 23/24 (96%) | 28/29 (97%) |
| WHO 2014 S-14.2 | non ESBL | 23/24 (96%) | 28/29 (97%) |
| WHO 2014 S-14.3 | non ESBL | 24/24 (100%) | 28/29 (97%) |
| WHO 2014 S-14.4 | non ESBL | 24/25 (96%) | 30/30 (100%) |
| WHO 2014 S-14.5 | non ESBL | 24/24 (100%) | 28/29 (97%) |
| WHO 2014 S-14.6 | non ESBL | 23/24 (96%) | 29/30 (97%) |
| WHO 2014 S-14.7 | ESBL-producer | 62/70 (89%) | 68/78 (87%) |
| WHO 2014 S-14.8 | non ESBL | 23/25 (92%) | 29/30 (97%) |
| WHO 2014 SH-14.1 | ESBL-producer | 50/55 (91%) | 59/64 (92%) |
| WHO 2014 SH-14.2 | ESBL-producer | 45/51 (88%) | 56/61 (92%) |
| WHO 2014 SH-14.3 | non ESBL | 21/21 (100%) | 25/26 (96%) |
| WHO 2014 SH-14.4 | non ESBL | 20/22 (91%) | 25/27 (93%) |

Table 18. EQAS participating laboratories' performance of *Campylobacter* strains identification

| EQAS iteration | No. of labs | Correct species | Strain no. | No. of results submitted | % correct identification | Deviating results (*) |
|----------------|-------------|------------------|------------|--------------------------|--------------------------|--|
| 2003 | 97 | <i>C. jejuni</i> | # 1 | 93 | 88% | <i>C. coli</i> (9) <i>C. lari</i> (3) |
| | 97 | <i>C. coli</i> | # 2 | 93 | 84% | <i>C. jejuni</i> (7) <i>C. lari</i> (4) <i>C. upsaliensis</i> (4) |
| 2004 | 109 | <i>C. lari</i> | # 1 | 97 | 79% | <i>C. coli</i> (11) <i>C. jejuni</i> (8) |
| | 109 | <i>C. jejuni</i> | # 2 | 109 | 87% | <i>C. coli</i> (8) <i>C. lari</i> (4) <i>C. upsaliensis</i> (2) |
| 2006 | 99 | <i>C. jejuni</i> | # 1 | 87 | 90% | <i>C. lari</i> (3) <i>C. coli</i> (3) <i>C. upsaliensis</i> (3) |
| | 99 | <i>C. coli</i> | # 2 | 95 | 65% | <i>C. lari</i> (19) <i>C. jejuni</i> (11) <i>C. upsaliensis</i> (2) |
| 2007 | 142 | <i>C. lari</i> | # 1 | 98 | 74% | <i>C. jejuni</i> (10) <i>C. coli</i> (9) <i>C. upsaliensis</i> (7) |
| | 142 | <i>C. coli</i> | # 2 | 102 | 76% | <i>C. lari</i> (3) <i>C. jejuni</i> (20) <i>C. upsaliensis</i> (2) |
| 2008 | 154 | <i>C. lari</i> | # 1 | 109 | 62% | <i>C. coli</i> (14) <i>C. jejuni</i> (18) <i>C. upsaliensis</i> (7) |
| | 154 | <i>C. lari</i> | # 2 | 109 | 62% | <i>C. coli</i> (10) <i>C. jejuni</i> (19) <i>C. upsaliensis</i> (13) |
| 2009 | 131 | <i>C. coli</i> | # 1 | 87 | 77% | <i>C. upsaliensis</i> (10) <i>C. jejuni</i> (9) <i>C. lari</i> (1) |
| | 131 | <i>C. jejuni</i> | # 2 | 87 | 95% | <i>C. upsaliensis</i> (3) <i>C. lari</i> (1) |
| 2010 | 130 | <i>C. jejuni</i> | # 1 | 88 | 92% | <i>C. coli</i> (4) <i>C. lari</i> (3) <i>C. upsaliensis</i> (1) |
| | 130 | <i>C. coli</i> | # 2 | 84 | 85% | <i>C. jejuni</i> (11) <i>C. lari</i> (2) <i>C. upsaliensis</i> (2) |
| 2011 | 132 | <i>C. coli</i> | # 1 | 81 | 59% | <i>C. jejuni</i> (19) <i>C. lari</i> (13) <i>C. upsaliensis</i> (1) |
| | 132 | <i>C. coli</i> | # 2 | 79 | 70% | <i>C. jejuni</i> (17) <i>C. lari</i> (5) <i>C. upsaliensis</i> (2) |
| 2012 | 135 | <i>C. jejuni</i> | # 1 | 112 | 96% | <i>C. coli</i> (4) |
| | 135 | <i>C. jejuni</i> | # 2 | 103 | 85% | <i>C. coli</i> (10) <i>C. lari</i> (5) <i>C. upsaliensis</i> (1) |
| 2013 | 123 | <i>C. coli</i> | # 1 | 95 | 82% | <i>C. jejuni</i> (13) <i>C. lari</i> (3) <i>C. upsaliensis</i> (1) |
| | 123 | <i>C. coli</i> | # 2 | 92 | 84% | <i>C. jejuni</i> (9) <i>C. lari</i> (4) <i>C. upsaliensis</i> (2) |
| 2014 | 101 | <i>C. coli</i> | #2 | 101 | 85 % | <i>C. jejuni</i> (8) <i>C. lari</i> (6) <i>C. upsaliensis</i> (1) |

*number of participants reporting the specified deviating result

Table 19. Region-based categorization of EQAS 2014 participating laboratories' performance of *Campylobacter* strains identification

| Region | Year | No. of labs | No. of strains identified | % strains correctly identified | Countries participating in the 2014 iteration |
|----------------------------|------|-------------|---------------------------|--------------------------------|--|
| Africa | 2009 | 9 | 15 | 53 | Cameroun, Kenya (2), Madagascar, Mauritius, Nigeria, Senegal, South Africa, Tunisia |
| | 2010 | 7 | 13 | 77 | |
| | 2011 | 10 | 19 | 32 | |
| | 2012 | 9 | 17 | 82 | |
| | 2013 | 9 | 17 | 41 | |
| | 2014 | 9 | 9 | 67 | |
| Central Asia & Middle East | 2009 | 14 | 27 | 85 | Bahrain, India (3), Islamic rep. of Iran(2), Israel |
| | 2010 | 13 | 26 | 89 | |
| | 2011 | 2 | 4 | 50 | |
| | 2012 | 11 | 22 | 96 | |
| | 2013 | 1 | 8 | 50 | |
| | 2014 | 7 | 7 | 57 | |
| Caribbean | 2009 | 2 | 4 | 100 | Barbados, Jamaica |
| | 2010 | 3 | 6 | 67 | |
| | 2011 | 1 | 2 | 0 | |
| | 2012 | 4 | 7 | 57 | |
| | 2013 | 2 | 4 | 100 | |
| | 2014 | 2 | 2 | 100 | |
| Europe | 2009 | 29 | 55 | 89 | Bulgaria, Czech Republic, Denmark (2), Germany (2), Greece, Hungary, Italy (8), Luxembourg (2), Malta, Poland (2), Serbia (2), Slovenia, Spain, Turkey |
| | 2010 | 29 | 57 | 97 | |
| | 2011 | 25 | 48 | 85 | |
| | 2012 | 29 | 56 | 95 | |
| | 2013 | 26 | 51 | 88 | |
| | 2014 | 26 | 26 | 89 | |
| North America | 2009 | 10 | 19 | 90 | Canada (6), USA (4) |
| | 2010 | 11 | 22 | 86 | |
| | 2011 | 9 | 18 | 78 | |
| | 2012 | 13 | 26 | 96 | |
| | 2013 | 10 | 18 | 100 | |
| | 2014 | 10 | 10 | 100 | |
| Oceania | 2009 | 2 | 4 | 100 | New Zealand |
| | 2010 | 2 | 3 | 100 | |
| | 2011 | 2 | 4 | 100 | |
| | 2012 | 2 | 4 | 100 | |
| | 2013 | 2 | 4 | 100 | |
| | 2014 | 1 | 1 | 100 | |

Table 19 (continued). Region-based categorization of EQAS 2014 participating laboratories' performance of *Campylobacter* strains identification

| Region | Year | No. of labs | No. of strains identified | % strains correctly identified | Countries participating in the 2014 iteration |
|----------------|------|-------------|---------------------------|--------------------------------|--|
| Russia | 2009 | 2 | 4 | 100 | Russia (3) |
| | 2010 | 2 | 4 | 100 | |
| | 2011 | 2 | 4 | 50 | |
| | 2012 | 5 | 10 | 80 | |
| | 2013 | 1 | 2 | 100 | |
| | 2014 | 3 | 3 | 100 | |
| Latin America | 2009 | 14 | 26 | 89 | Argentina, Bolivia, Brazil (2), Chile (2), Colombia (3), Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Panama, Paraguay, Peru, Suriname, Uruguay (2), Venezuela (2) |
| | 2010 | 19 | 37 | 78 | |
| | 2011 | 19 | 37 | 49 | |
| | 2012 | 22 | 40 | 95 | |
| | 2013 | 20 | 36 | 83 | |
| | 2014 | 22 | 22 | 86 | |
| Southeast Asia | 2009 | 10 | 20 | 90 | Brunei Darussalam, Cambodia, Japan (2), LAO PDR, Malaysia, Philippines, Rep of Korea (2), Taiwan, Thailand (3) |
| | 2010 | 14 | 27 | 93 | |
| | 2011 | 12 | 24 | 67 | |
| | 2012 | 17 | 33 | 85 | |
| | 2013 | 15 | 28 | 89 | |
| | 2014 | 13 | 13 | 92 | |
| China | 2009 | 12 | 24 | 92 | China (8) |
| | 2010 | 10 | 20 | 85 | |
| | 2011 | - | - | - | |
| | 2012 | - | - | - | |
| | 2013 | 5 | 10 | 90 | |
| | 2014 | 8 | 8 | 75 | |

Table 20. EQAS participants' performance of *Campylobacter* strains antimicrobial susceptibility testing

| EQAS iteration | No. of labs | % correct test results | % major deviations (S → R)^ | % very major deviations (R → S)^ | % critical deviations (R → S & S → R)^ |
|----------------|-------------|------------------------|-----------------------------|----------------------------------|--|
| 2009 | 25 | 91.4 | 4.5 | 4.1 | 8.6 |
| 2010 | 37 | 91.3 | 4.2 | 4.5 | 8.7 |
| 2011 | 38 | 93.8 | 2.8 | 3.4 | 6.2 |
| 2012 | 47 | 93.6 | 5.0 | 1.5 | 6.4 |
| 2013 | 47 | 92.4 | 5.0 | 2.6 | 7.6 |
| 2014 | 50 | 91.2 | 1.6 | 7.2 | 8.8 |

^S. susceptible; R. resistant

Table 21. Antimicrobial susceptibility test results (number of R/S) for the EQAS 2014 *Campylobacter* strains*

| Strain | Antimicrobial [^] | | | | | |
|-----------------|----------------------------|--------|--------|--------|--------|--------|
| | CIP | ERY | GEN | NAL | STR | TET |
| WHO 2014 C-14.2 | 45/0/4 | 1/0/45 | 3/0/42 | 37/0/5 | 20/0/4 | 40/0/5 |

[^]For antimicrobial abbreviations. see List of Abbreviations page 1

*In bold: expected interpretation. Grey cell: <90% of laboratories did correct interpretation. R. resistant; S. susceptible

Table 22. EQAS participants' performance of *Campylobacter* antimicrobial susceptibility testing categorized by antimicrobial

| EQAS iteration | No. of labs | Lab performance | Antimicrobial | | | | | | |
|----------------|-------------|------------------------|---------------|-----|------|------|------|------|------|
| | | | CHL | CIP | ERY | GEN | NAL | STR | TET |
| 2009 | 25 | No. of tests | 37 | 46 | 46 | 43 | 41 | 34 | 45 |
| | | % critical deviations* | 8.1 | 6.5 | 10.9 | 2.3 | 9.8 | 11.8 | 11.1 |
| 2010 | 37 | No. of tests | 44 | 70 | 71 | 59 | 53 | 39 | 68 |
| | | % critical deviations* | 4.5 | 7.1 | 11.3 | 10.2 | 7.5 | 10.3 | 8.8 |
| 2011 | 38 | No. of tests | 41 | 67 | 62 | 65 | 62 | 30 | 60 |
| | | % critical deviations* | 0.0 | 6.0 | 6.5 | 3.1 | 8.1 | 13.3 | 8.3 |
| 2012 | 47 | No. of tests | 70 | 84 | 81 | 81 | 39 | 53 | 74 |
| | | % critical deviations* | 4.3 | 6.0 | 6.2 | 7.4 | 5.1 | 11.3 | 5.4 |
| 2013 | 47 | No. of tests | 71 | 90 | 87 | 82 | 79 | 51 | 86 |
| | | % critical deviations* | 5.6 | 6.7 | 8.0 | 0.0 | 8.9 | 23.5 | 8.1 |
| 2014 | 50 | No. of tests | - | 49 | 46 | 45 | 42 | 24 | 45 |
| | | % critical deviations* | - | 8.2 | 2.2 | 6.7 | 11.9 | 16.7 | 11.1 |

[^]For antimicrobial abbreviations. see List of Abbreviations page 1

*R → S & S → R (R. resistant; S. susceptible)

Table 23. Region-based categorization of EQAS 2014 participants' performance of antimicrobial susceptibility testing of *Campylobacter* strains

| Region | Year | No. of labs | % correct test result | % major deviations (S → R)^ | % very major deviations (S → R)^ | % critical deviations (R→S & S→R)^ | Countries participating in the 2014 iteration |
|----------------------------|------|-------------|-----------------------|-----------------------------|----------------------------------|------------------------------------|--|
| Africa | 2009 | 2 | 75.0 | 10.7 | 14.3 | 25.0 | Cameroun, Kenya (2), Madagascar, Nigeria, Senegal, Tunisia |
| | 2010 | 2 | 95.2 | 0.0 | 4.8 | 4.8 | |
| | 2011 | 7 | 85.0 | 3.3 | 11.7 | 15.0 | |
| | 2012 | 4 | 94.3 | 0.0 | 5.7 | 5.7 | |
| | 2013 | 5 | 90.9 | 5.5 | 3.6 | 9.1 | |
| | 2014 | 7 | 51.5 | 39.4 | 9.1 | 48.5 | |
| Central Asia & Middle East | 2009 | 0 | - | - | - | - | India, Islamic rep. of Iran, Israel |
| | 2010 | 0 | - | - | - | - | |
| | 2011 | 1 | 75.0 | 0.0 | 25.0 | 25.0 | |
| | 2012 | 2 | 93.8 | 6.3 | 0.0 | 6.3 | |
| | 2013 | 3 | 93.3 | 3.3 | 3.3 | 6.7 | |
| | 2014 | 3 | 100.0 | 0.0 | 0.0 | 0.0 | |
| China | 2009 | 2 | 95.2 | 4.8 | 0.0 | 4.8 | China (6) |
| | 2010 | 1 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2011 | 0 | - | - | - | - | |
| | 2012 | 2 | 88.5 | 7.7 | 3.8 | 11.5 | |
| | 2013 | 3 | 95.2 | 2.4 | 2.4 | 4.8 | |
| | 2014 | 6 | 100.0 | 0.0 | 0.0 | 0.0 | |
| Caribbean | 2009 | 0 | - | - | - | - | Cuba, Jamaica |
| | 2010 | 0 | - | - | - | - | |
| | 2011 | 0 | - | - | - | - | |
| | 2012 | 1 | 75.0 | 25.0 | 0.0 | 25.0 | |
| | 2013 | 1 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2014 | 2 | 100.0 | 0.0 | 0.0 | 0.0 | |
| Europe | 2009 | 10 | 94.8 | 3.0 | 2.2 | 5.2 | Denmark, Germany, Greece, Hungary, Italy (3), Luxembourg (2), Malta, Poland (2), Serbia, Slovenia, Spain, Turkey |
| | 2010 | 13 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2011 | 11 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2012 | 16 | 97.3 | 1.6 | 1.1 | 2.7 | |
| | 2013 | 16 | 94.9 | 3.5 | 1.5 | 5.1 | |
| | 2014 | 16 | 97.4 | 1.3 | 1.3 | 2.6 | |
| North America | 2009 | 2 | 100.0 | 0.0 | 0.0 | 0.0 | Canada, USA (3) |
| | 2010 | 5 | 93.8 | 6.3 | 0.0 | 6.3 | |
| | 2011 | 5 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2012 | 5 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2013 | 3 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2014 | 4 | 100.0 | 0.0 | 0.0 | 0.0 | |

^S. susceptible; R. resistant

Table 23 (continued). Region-based categorization of EQAS 2014 participants' performance of antimicrobial susceptibility testing of *Campylobacter* strains

| Region | Year | No. of labs | % correct test result | % major deviations (S → R)^ | % very major deviations (S → R)^ | % critical deviations (R→S & S→R)^ | Countries participating in the 2014 iteration |
|----------------|------|-------------|-----------------------|-----------------------------|----------------------------------|------------------------------------|--|
| Oceania | 2009 | 0 | - | - | - | - | - none - |
| | 2010 | 0 | - | - | - | - | |
| | 2011 | 1 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2012 | 0 | - | - | - | - | |
| | 2013 | 0 | - | - | - | - | |
| | 2014 | 0 | - | - | - | - | |
| Russia | 2009 | 0 | - | - | - | - | - none - |
| | 2010 | 1 | 78.6 | 7.1 | 14.3 | 21.4 | |
| | 2011 | 1 | 100.0 | 0.0 | 0.0 | 0.0 | |
| | 2012 | 0 | - | - | - | - | |
| | 2013 | 0 | - | - | - | - | |
| | 2014 | 0 | - | - | - | - | |
| Latin America | 2009 | 5 | 93.2 | 6.8 | 0.0 | 6.8 | Argentina, Brazil, Chile (2), Costa Rica, Paraguay |
| | 2010 | 8 | 89.6 | 6.0 | 4.5 | 10.4 | |
| | 2011 | 7 | 96.8 | 0.0 | 3.2 | 3.2 | |
| | 2012 | 7 | 95.2 | 3.2 | 1.6 | 4.8 | |
| | 2013 | 7 | 92.4 | 4.5 | 3.0 | 7.6 | |
| | 2014 | 6 | 100.0 | 0.0 | 0.0 | 0.0 | |
| Southeast Asia | 2009 | 4 | 84.4 | 4.4 | 11.1 | 15.6 | Philippines, Rep of Korea (2), Thailand (3) |
| | 2010 | 7 | 77.2 | 9.8 | 13.0 | 22.9 | |
| | 2011 | 5 | 85.1 | 9.0 | 6.0 | 14.0 | |
| | 2012 | 10 | 85.8 | 13.3 | 0.9 | 14.2 | |
| | 2013 | 9 | 84.8 | 10.7 | 4.5 | 15.2 | |
| | 2014 | 6 | 87.5 | 12.5 | 0.0 | 12.5 | |

^S. susceptible; R. resistant

Table 24. EQAS participants' performance of antimicrobial susceptibility testing of *Campylobacter jejuni* ATCC 33560

| | Method used | Incubation conditions | Labs' performance ^{1,2} | Antimicrobial ³ | | | | | |
|------------------|---------------|-----------------------|----------------------------------|----------------------------|-----|-----|-----|-----|-----|
| | | | | CHL | CIP | ERY | GEN | NAL | TET |
| EQAS 2010 (N=20) | Microdilution | 42°C / 24h | No. ¹ | 3 | 6 | 6 | 6 | 4 | 6 |
| | | | % ² | 67 | 83 | 100 | 83 | 75 | 83 |
| | Microdilution | 36-37°C / 48h | No. ¹ | 5 | 8 | 8 | 8 | 7 | 8 |
| | | | % ² | 80 | 88 | 88 | 75 | 86 | 88 |
| | Agardilution | 42°C / 24h | No. ¹ | - | 6 | 6 | 6 | - | - |
| | | | % ² | - | 100 | 83 | 83 | - | - |
| | Agardilution | 36-37°C / 48h | No. ¹ | - | 0 | 0 | 0 | - | - |
| | | | % ² | - | 0 | 0 | 0 | - | - |
| EQAS 2011 (N=26) | Microdilution | 42°C / 24h | No. ¹ | 4 | 9 | 9 | 8 | 7 | 9 |
| | | | % ² | 100 | 67 | 100 | 88 | 100 | 67 |
| | Microdilution | 36-37°C / 48h | No. ¹ | 6 | 8 | 6 | 8 | 7 | 7 |
| | | | % ² | 83 | 88 | 100 | 75 | 86 | 86 |
| | Agardilution | 42°C / 24h | No. ¹ | - | 8 | 8 | 8 | - | - |
| | | | % ² | - | 88 | 63 | 100 | - | - |
| | Agardilution | 36-37°C / 48h | No. ¹ | - | 1 | 1 | 1 | - | - |
| | | | % ² | - | 0 | 0 | 100 | - | - |
| EQAS 2012 (N=34) | Microdilution | 42°C / 24h | No. ¹ | 9 | 12 | 12 | 12 | 10 | 12 |
| | | | % ² | 67 | 75 | 83 | 83 | 80 | 75 |
| | Microdilution | 36-37°C / 48h | No. ¹ | 7 | 9 | 8 | 8 | 8 | 8 |
| | | | % ² | 100 | 89 | 100 | 63 | 88 | 88 |
| | Agardilution | 42°C / 24h | No. ¹ | - | 9 | 7 | 9 | - | - |
| | | | % ² | - | 89 | 86 | 89 | - | - |
| | Agardilution | 36-37°C / 48h | No. ¹ | - | 4 | 4 | 4 | - | - |
| | | | % ² | - | 50 | 100 | 100 | - | - |
| | Overall | Overall | No. ¹ | 34 | 80 | 75 | 78 | 43 | 50 |
| | | | % ² | 82 | 81 | 88 | 83 | 86 | 80 |

¹No.. number of labs performing the analysis, ²%. percentage of labs reporting correct results, ³For antimicrobial abbreviations: see List of Abbreviations page 1, -, not determined

Table 24 (continued). EQAS participants' performance of antimicrobial susceptibility testing of *Campylobacter jejuni* ATCC 33560

| | Method used | Incubation conditions | Labs' performance ^{1,2} | Antimicrobial ³ | | | | | |
|------------------|---------------|-----------------------|----------------------------------|----------------------------|-----|-----|-----|-----|-----|
| | | | | CHL | CIP | ERY | GEN | NAL | TET |
| EQAS 2013 (N=47) | Microdilution | 42°C / 24h | No. ¹ | 6 | 8 | 8 | 8 | 7 | 8 |
| | | | % ² | 83 | 88 | 100 | 88 | 86 | 100 |
| | Microdilution | 36-37°C / 48h | No. ¹ | 8 | 12 | 12 | 11 | 11 | 12 |
| | | | % ² | 88 | 92 | 83 | 73 | 91 | 75 |
| | Agardilution | 42°C / 24h | No. ¹ | - | 9 | 9 | 8 | - | - |
| | | | % ² | - | 89 | 67 | 75 | - | - |
| | Agardilution | 36-37°C / 48h | No. ¹ | - | 7 | 7 | 6 | - | - |
| | | | % ² | - | 86 | 86 | 100 | - | - |
| | Overall | Overall | No. ¹ | 14 | 36 | 36 | 33 | 18 | 20 |
| | | | % ² | 86 | 89 | 83 | 82 | 89 | 85 |
| EQAS 2014 (N=32) | Microdilution | 42°C / 24h | No. ¹ | - | 10 | 10 | 10 | 10 | 10 |
| | | | % ² | - | 90 | 100 | 80 | 100 | 90 |
| | Microdilution | 36-37°C / 48h | No. ¹ | - | 10 | 10 | 9 | 8 | 10 |
| | | | % ² | - | 100 | 80 | 89 | 100 | 100 |
| | Agardilution | 42°C / 24h | No. ¹ | - | 7 | 7 | 7 | - | - |
| | | | % ² | - | 100 | 71 | 100 | - | - |
| | Agardilution | 36-37°C / 48h | No. ¹ | - | 5 | 5 | 5 | - | - |
| | | | % ² | - | 80 | 80 | 100 | - | - |
| | Overall | Overall | No. ¹ | - | 32 | 32 | 31 | 18 | 20 |
| | | | % ² | - | 94 | 84 | 90 | 100 | 95 |

¹No.. number of labs performing the analysis, ²%, percentage of labs reporting correct results, ³For antimicrobial abbreviations: see List of Abbreviations page 1, -, not determined

Table 25. EQAS participating laboratories' performance of unknown strain identification

| EQAS iteration | Strain ID | No. of participating labs | Percentage (%) of labs performing correct identification |
|----------------|---|---------------------------|--|
| 2003 | <i>E. coli</i> O157 | 115 | 99 |
| 2004 | <i>Shigella flexneri</i> | 121 | 94 (<i>Shigella</i>) 74 (<i>S. flexneri</i>) |
| 2006 | <i>Yersinia enterocolitica</i> O3 | 134 | 93 (<i>Yersinia</i>) 89 (<i>Y. enterocolitica</i>) 66 (<i>Y. enterocolitica</i> O3) |
| 2007 | <i>Vibrio parahaemolyticus</i> | 86 | 83 |
| 2008 | <i>Enterobacter sakasakii</i> | 128 | 92 |
| 2009 | <i>Vibrio mimicus</i> | 56 | 48 |
| 2010 | <i>Citrobacter</i> spp. | 115 | 90 |
| 2011 | <i>Aeromonas hydrophila</i> | 106 | 83 |
| 2012 | <i>Salmonella</i> Paratyphi B var. Java | 134 | 23% (<i>Salmonella</i> spp) 7% (<i>Salmonella</i> O:B) 24% (<i>Salmonella</i> Paratyphi B var. java. In total 54% Deviations: <i>Citrobacter freundii</i> (1), <i>Edwardsiella</i> sp (1), <i>Escherichia fergusonii</i> (1), <i>Proteus mirabilis</i> (1), <i>Salmonella</i> serovar X* (24), <i>Salmonella</i> serovar Paratyphi B (34) * incorrect serovar |
| 2013 | <i>E. coli</i> O157:H16 non-VTEC | 129 | 82% including: <i>Escherichia coli</i> non-VTEC <i>Escherichia coli</i> O157 non-VTEC <i>Escherichia coli</i> O157:H16 non-VTEC <i>E. coli</i> non-VTEC <i>E. coli</i> O157 non-VTEC <i>E. coli</i> O157:H16 non-VTEC Deviations: <i>Escherichia coli</i> O157 H7 (9), <i>Escherichia hermannii</i> (2), <i>Shigella sonnei</i> (2), <i>E.coli</i> EHEC, <i>Escherichia coli</i> O114: nonmotile, <i>Escherichia coli</i> O157:H12, <i>Escherichia coli</i> O157:H16, Stx1+, <i>Escherichia coli</i> O157:H45, <i>Escherichia coli</i> O157:H7/ Verotoxin negative, <i>Escherichia fergusonii</i> , <i>Escherichia coli</i> STEC, <i>Vibrio mimicus</i> , <i>Citrobacter amalonaticus</i> |
| 2014 | <i>Yersinia pseudotuberculosis</i> | 122 | 74% Correct, including: <i>Yersinia pseudotuberculosis</i> <i>Yersinia pseudotuberculosis</i> API 20 E [1014100] <i>Yersinia pseudotuberculosis</i> I <i>Yersinia pseudotuberculosis</i> O:1b <i>Yersinia pseudotuberculosis</i> O1 YERSINIA SPECIES Deviations: <i>Acinetobacter baumannii</i> , <i>Bacterium Sphingomonas paucimobilis</i> , <i>Burkholderia</i> sp., <i>Citrobacter freundii</i> , <i>Corynebacterium species</i> , Gram negative <i>sphingomonas paucimobilis</i> , HELICOBACTER , <i>Pasteurella maisi</i> , <i>Pasteurella</i> sp., <i>Pseudomonas luteola</i> , <i>Rhizobium radiobacter</i> (5), <i>Salmonella typhi</i> , <i>Shigella flexneri</i> , <i>Sphingomonas paucimobilis</i> (4), unknown, <i>Vibrio metschnikovii</i> , <i>Yersinia enterocolitica</i> (4), <i>Yersinia similis</i> , <i>Yestina pestis</i> |

M00-06-001/01.12.2011

Kgs. Lyngby, Denmark, April 2014

SIGN-UP FOR EQAS 2014

Greetings to the WHO Global Foodborne Infections Network (WHO GFN) Members:

WHO GFN strives to increase the quality of laboratory-based surveillance of *Salmonella* and other foodborne pathogens by encouraging national and regional reference laboratories that attended WHO GFN training courses to participate in the External Quality Assurance System (EQAS). The 2013 EQAS cycle is completed, and we are pleased to announce the launch of the 2014 EQAS cycle.

WHY PARTICIPATE IN EQAS?

EQAS provides the opportunity for proficiency testing which is considered an important tool for the production of reliable laboratory results of consistently good quality.

WHAT IS OFFERED IN EQAS?

This year, WHO EQAS offers the following components:

- Serogrouping, serotyping and antimicrobial susceptibility testing of eight *Salmonella* isolates;
- Serotyping and antimicrobial susceptibility testing of four *Shigella* isolates;
- Species identification and antimicrobial susceptibility testing of two *Campylobacter* isolates;
- Identification of one unknown bacterial isolate.

WHO SHOULD PARTICIPATE IN EQAS 2014?

All national and regional reference laboratories which perform analysis on *Salmonella*, *Shigella* and/or *Campylobacter* and are interested in participating in an external quality assurance program are invited to participate.

We expect that all national and regional reference laboratories that attended WHO GFN Training Courses will participate in EQAS.

The WHO GFN Regional Centers in cooperation with the EQAS Coordinator will evaluate the list of laboratories that sign up for EQAS 2014. Laboratories which signed up and received bacterial isolates in year 2013 but did not submit any result should provide a consistent explanation for this if they want to participate in 2014.

COST FOR PARTICIPATING IN EQAS

There is no participation fee in EQAS 2014. Laboratories should, however, cover the expenses for parcel shipment if they can afford it. If FedEx has 'Dangerous Goods-service' in your country or if you have a DHL-account no, please provide your FedEx or DHL import account number (for import of UN3373 Biological Substance Category B) in the sign-up form or, alternatively, to the EQAS Coordinator (please find contact information below). We need this information at this stage to save time and resources. Participating laboratories are responsible for paying any expenses related to taxes or custom fees applied by their country.

HOW TO SIGN- UP FOR EQAS 2014

This link will open a sign-up webpage: <http://eqas.food.dtu.dk/who/signup>

In this webpage, you will be asked to provide the following information:

- Name of institute, department, laboratory, and contact person
- Complete mailing address for shipment of bacterial isolates (no post-office box number)
- Telephone and fax number, e-mail address
- FedEx or DHL import account number (if available)
- Approximate number of *Salmonella* isolates annually serogrouped/serotyped
- Approximate number of *Salmonella* isolates annually tested for antimicrobial susceptibility
- Availability of ATCC reference strains
- Components of EQAS 2014 you plan to participate in
- Level of reference function in your country

If you experience any problem in the sign-up webpage, please try again a few days later. If problems persist after several attempts, please contact the EQAS Coordinator Susanne Karlsmose: E-mail suska@food.dtu.dk; fax +45 3588 6341.

TIMELINE FOR SHIPMENT OF ISOLATES AND AVAILABILITY OF PROTOCOLS

Due to increased number of participants in WHO EQAS, a number of different institutions will ship the bacterial isolates, and you will receive information concerning the institution shipping your parcel. The bacterial isolates will be shipped between August and September 2014.

In order to minimize delays, **please send a valid import permit to the EQAS coordinator**. Please apply for a permit to receive the following (according to your level of participation): “UN3373, Biological Substance Category B”: eight *Salmonella* strains, four *Shigella* strains, two *Campylobacter*, one *Campylobacter* reference strain (for new participants performing antimicrobial susceptibility testing on *Campylobacter*), one *Escherichia coli* reference strain (for new participants performing antimicrobial susceptibility testing on *Salmonella* and/or *Shigella*) and an unknown isolate (enteric bacteria) between August and September 2014.

Protocols and all relevant information will be available for download from the website <http://www.antimicrobialresistance.dk/233-169-215-eqas.htm>.

DEADLINE FOR SUBMITTING RESULTS TO THE NATIONAL FOOD INSTITUTE

Results must be submitted to the National Food Institute (DTU Food) by **31st December 2014** through the password-protected website. An evaluation report will be generated upon submission of results. Full anonymity is ensured, and only DTU Food and the WHO GFN Regional Centre in your region will have access to your results.

Deadline for sign-up for EQAS 2014 is 30th May 2014

Appendix 3, page 1 of 1

| | | | Ampicillin | | Cefotaxime | | Ceftazidime | | Ceftriaxone | | Chloramphenicol | | Ciprofloxacin | | Gentamicin | | Nalidixic acid | | Sulfonamides | | Tetracycline | | Trimethoprim | | Trim/Sulfa | |
|-----------------|---|------------------|------------|--------|------------|--------|-------------|--------|-------------|--------|-----------------|--------|---------------|--------|------------|--------|----------------|--------|--------------|--------|--------------|--------|--------------|--------|------------|--------|
| | | | AMP | | CTX | | CAZ | | CRO | | CHL | | CIP | | GEN | | NAL | | SMX | | TET | | TMP | | SXT | |
| WHO 2014 S-14.1 | <i>Salmonella</i> Orion / Orion var. 15 | 3,15:y:1,5 | <= 1 | SUSC | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | <= 0.015 | SUSC | <= 0.5 | SUSC | <= 4 | SUSC | = 32 | SUSC | <= 2 | SUSC | <= 0.25 | SUSC | <= 0.12 | SUSC |
| WHO 2014 S-14.2 | <i>Salmonella</i> Hadar / Istanbul | 8:z10:e,n,x | <= 1 | SUSC | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | = 0.5 | INTER | <= 0.5 | SUSC | > 128 | RESIST | = 32 | SUSC | = 64 | RESIST | <= 0.25 | SUSC | <= 0.12 | SUSC |
| WHO 2014 S-14.3 | <i>Salmonella</i> Illa 48:g,z51:- | Ill a 48:g,z51:- | <= 1 | SUSC | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | = 0.03 | SUSC | <= 0.5 | SUSC | = 8 | SUSC | = 16 | SUSC | <= 2 | SUSC | <= 0.25 | SUSC | <= 0.12 | SUSC |
| WHO 2014 S-14.4 | <i>Salmonella</i> Napoli | 9,12:l,z13:e,n,x | > 64 | RESIST | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | = 0.03 | SUSC | <= 0.5 | SUSC | <= 4 | SUSC | > 1024 | RESIST | > 64 | RESIST | > 32 | RESIST | > 4 | RESIST |
| WHO 2014 S-14.5 | <i>Salmonella</i> Ohio | 6,7:b:l,w | <= 1 | SUSC | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | = 0.03 | SUSC | <= 0.5 | SUSC | <= 4 | SUSC | = 64 | SUSC | <= 2 | SUSC | <= 0.25 | SUSC | <= 0.12 | SUSC |
| WHO 2014 S-14.6 | <i>Salmonella</i> Enteritidis | 9,12:g,m:- | = 2 | SUSC | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | = 0.03 | SUSC | > 32 | RESIST | <= 4 | SUSC | > 1024 | RESIST | <= 2 | SUSC | <= 0.25 | SUSC | <= 0.12 | SUSC |
| WHO 2014 S-14.7 | <i>Salmonella</i> Typhimurium | 4,12:i:1,2 | > 64 | RESIST | > 4 | RESIST | > 8 | RESIST | > 64 | RESIST | > 128 | RESIST | = 1 | RESIST | > 32 | RESIST | > 128 | RESIST | > 1024 | RESIST | > 64 | RESIST | > 32 | RESIST | > 4 | RESIST |
| WHO 2014 S-14.8 | <i>Salmonella</i> Kentucky | 8:i:6 | > 64 | RESIST | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | > 8 | RESIST | = 16 | RESIST | > 128 | RESIST | > 1024 | RESIST | = 64 | RESIST | <= 0.25 | SUSC | <= 0.12 | SUSC |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|-------------|--|------|--------|---------|--------|--------|--------|---------|--------|------|--------|----------|--------|--------|--------|-------|--------|--------|--------|------|--------|---------|--------|--------|--------|
| WHO 2014 SH-14.1 | sonnei | | > 64 | RESIST | > 4 | RESIST | = 4 | RESIST | = 64 | RESIST | <= 8 | SUSC | = 0.12 | INTER | = 1 | SUSC | = 64 | RESIST | > 1024 | RESIST | = 64 | RESIST | > 32 | RESIST | > 4 | RESIST |
| WHO 2014 SH-14.2 | sonnei | | > 64 | RESIST | > 4 | RESIST | = 2 | RESIST | = 64 | RESIST | <= 8 | SUSC | <= 0.015 | SUSC | > 32 | RESIST | <= 4 | SUSC | > 1024 | RESIST | = 64 | RESIST | > 32 | RESIST | > 4 | RESIST |
| WHO 2014 SH-14.3 | flexneri 2b | | > 64 | RESIST | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | = 32 | RESIST | = 1 | RESIST | = 1 | SUSC | > 128 | RESIST | > 1024 | RESIST | = 64 | RESIST | > 32 | RESIST | > 4 | RESIST |
| WHO 2014 SH-14.4 | boydii 2 | | > 64 | RESIST | <= 0.25 | SUSC | <= 0.5 | SUSC | <= 0.25 | SUSC | <= 8 | SUSC | <= 0.015 | SUSC | <= 0.5 | SUSC | <= 4 | SUSC | > 1024 | RESIST | = 32 | RESIST | <= 0.25 | SUSC | = 0.25 | SUSC |

| | | | Ciprofloxacin | Erythromycin | Gentamicin | Nalidixic acid | Streptomycin | Tetracycline | | | | | | |
|-----------------|--|--|---------------|--------------|------------|----------------|--------------|--------------|------|--------|------|--------|------|--------|
| | | | CIP | ERY | GEN | NAL | STR | TET | | | | | | |
| WHO 2014 C-14.1 | No strain, this year, with this code (due to problems with the lyophilization) | | | | | | | | | | | | | |
| WHO 2014 C-14.2 | C. coli | | = 8 | RESIST | <= 1 | SUSC | <= 0.12 | SUSC | = 64 | RESIST | > 16 | RESIST | > 64 | RESIST |

| | |
|------------|------------------------------------|
| WHO B-14.1 | <i>Yersinia pseudotuberculosis</i> |
|------------|------------------------------------|

PROTOCOL for

- serotyping and antimicrobial susceptibility testing of *Salmonella*
- serotyping and antimicrobial susceptibility testing of *Shigella*
- identification and antimicrobial susceptibility testing of *Campylobacter*
- identification of an unknown enteric pathogen

| | | |
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1 INTRODUCTION

In 2000, the Global Foodborne Infections Network (formerly known as WHO Global Salm-Surv) launched an External Quality Assurance System (EQAS). The EQAS is organized by the National Food Institute, Technical University of Denmark (DTU Food), in collaboration with partners and Regional Sites in WHO GFN.

Various aspects of the proficiency test scheme may from time to time be subcontracted. When subcontracting occurs, it is placed with a competent subcontractor and the National Food Institute is responsible for the subcontractor's work.

The WHO EQAS 2014 includes

- serotyping and antimicrobial susceptibility testing of eight *Salmonella* strains,
- serotyping and antimicrobial susceptibility testing of four *Shigella* strains,

- antimicrobial susceptibility testing of the *Escherichia coli* ATCC 25922 (CCM 3954) reference strain for quality control,
- identification and antimicrobial susceptibility testing of one thermophilic *Campylobacter* isolate (note, this year, only one *Campylobacter* strain is included, due to unfortunate issues with the lyophilisation of the strains),
- antimicrobial susceptibility testing of *Campylobacter jejuni* ATCC 33560 (CCM 6214) reference strain for quality control,
- identification of one 'unknown' bacterial isolate.

All participants will receive the strains according to the information they reported in the sign-up form.

The above-mentioned reference strains are included in the parcel only for new participants of the EQAS who did not receive them previously. The reference strains are original CERTIFIED cultures provided free of charge, and should be used for future internal quality control for antimicrobial susceptibility testing in your laboratory. The reference strains will not be included in the years to come. Therefore, please take proper care of these strains. Handle and maintain them as suggested in the manual 'Subculture and Maintenance of QC Strains' available on the WHO Collaborating Centre website (see www.antimicrobialresistance.dk).

2 OBJECTIVES

The main objective of this EQAS is to support laboratories to assess and if necessary improve the quality of serotyping and antimicrobial susceptibility testing of enteric human pathogens, especially *Salmonella*. A further objective is to assess and improve the comparability of surveillance data on *Salmonella* serotypes and antimicrobial susceptibility reported by different laboratories. Therefore, the laboratory work for this EQAS should be done by using the methods routinely used in your laboratory.

3 OUTLINE OF THE EQAS 2014

3.1 Shipping, receipt and storage of strains

In September 2014 around 200 laboratories located worldwide will receive a parcel containing eight *Salmonella* strains, four *Shigella* strains, one *Campylobacter* strain and one 'unknown' bacterial isolate (according to information reported in the sign-up form). An *E. coli* ATCC 25922 reference strain and a *C. jejuni* ATCC 33560 reference strain will be included for participants who signed up to perform antimicrobial susceptibility testing (AST) and did not receive them previously. All provided strains belong to UN3373, Biological substance category B. ESBL-producing strains could be included in the selected material.

Please confirm receipt of the parcel through the confirmation form enclosed in the shipment

The *Salmonella* and *Shigella* strains, and the ‘unknown’ bacterial isolate are shipped as agar stab cultures whereas the reference strains and the *Campylobacter* strain are shipped lyophilised. On arrival, the agar stab cultures must be subcultured and prepared for storage in your strain collection (e.g. in a -80°C freezer). This set of cultures should serve as reference if discrepancies are detected during the testing (e.g. they can be used to detect errors such as mis-labelling or contamination). Lyophilised strains must be reconstituted, and you can find below a suggested procedure.

3.2 Serotyping of *Salmonella*

The eight *Salmonella* strains should be serotyped by using the method routinely used in the laboratory. If you do not have all the necessary antisera please go as far as you can in the identification and report the serogroup, since also serogroup results will be evaluated. Serogroups should be reported using terms according to Kauffmann-White-Le Minor (Grimont and Weill, 2007. 9th ed. Antigenic formulae of the *Salmonella* serovars. WHO Collaborating Centre for Reference and Research on *Salmonella*).

Please fill in information concerning the brand of antisera used for typing in the fields available in the database for entering results. In addition, we kindly ask you to report which antisera you think are required to complete the serotyping, if relevant.

3.3 Antimicrobial susceptibility testing of *Salmonella*, *Shigella* and *Escherichia coli* ATCC 25922

The *Salmonella* and *Shigella* strains as well as the *E. coli* ATCC 25922 reference strain should be tested for susceptibility towards as many as possible of the antimicrobials mentioned in the test form. Please use the methods routinely used in your laboratory.

For reconstitution of the *E. coli* reference strain, please see the document ‘Instructions for opening and reviving lyophilised cultures’ on the WHO Collaborating Centre website (see www.antimicrobialresistance.dk).

Testing of gentamicin susceptibility may be valuable for monitoring purposes. Therefore we kindly ask you to disregard, for the purpose of this proficiency trial, that the Clinical and Laboratory Standards Institute (CLSI) guidelines state that *Salmonella* and *Shigella* should not be reported as susceptible to aminoglycosides.

The breakpoints used in this EQAS for interpreting MIC results are in accordance with CLSI values (Table 1). Consequently, interpretation of MIC results will lead to categorization of strains into three categories: resistant (R), intermediate (I) and susceptible (S). In the evaluation report you

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receive upon result submission, you can find that obtained interpretations in accordance with the expected interpretation will be defined as 'correct', whereas deviations from the expected interpretation will be defined as 'minor' (I ↔ S or I ↔ R), 'major' (S interpreted as R) or 'very major' (R interpreted as S).

Please report the breakpoints that you routinely use in your laboratory for interpretation of antimicrobial susceptibility test results in the fields available in the database (or in the test forms).

Table 1. Interpretive breakpoint for *Salmonella* and *Shigella* antimicrobial susceptibility testing

| Antimicrobials | Reference value, MIC (µg/mL) | | | Reference value, Disk diffusion (mm) | | |
|---|------------------------------|--------------|-----------|---------------------------------------|-------------------------------------|---------------------------------------|
| | Sensitive | Intermediate | Resistant | Resistant | Intermediate | Sensitive |
| Ampicillin, AMP | ≤8 | 16 | ≥32 | ≤13 | 14-16 | ≥17 |
| Cefotaxime, CTX* | ≤1 | - | >1 | ≤27 | - | >27 |
| Ceftazidime, CAZ* | ≤1 | - | >1 | ≤22 | - | >22 |
| Ceftriaxone, CRO* | ≤1 | - | >1 | ≤25 | - | >25 |
| Chloramphenicol, CHL | ≤8 | 16 | ≥32 | ≤12 | 13-17 | ≥18 |
| Ciprofloxacin, CIP | ≤0.06** | 0.12-0.5** | ≥1** | ≤20mm (5µg)** or <23mm (1µg)*** | 21-30mm (5µg)** or - (1µg)*** | ≥31mm (5µg)** or ≥23mm (1µg)*** |
| Gentamicin, GEN | ≤4 | 8 | ≥16 | ≤12 | 13-14 | ≥15 |
| Nalidixic acid, NAL | ≤16 | - | ≥32 | ≤13 | 14-18 | ≥19 |
| Sulfonamides, SMX | ≤256 | - | ≥512 | ≤12 | 13-16 | ≥17 |
| Tetracycline, TET | ≤4 | 8 | ≥16 | ≤11 | 12-14 | ≥15 |
| Trimethoprim, TMP | ≤8 | - | ≥16 | ≤10 | 11-15 | ≥16 |
| Trimethoprim + sulfamethoxazole, TMP+SMX, SXT | ≤2/38 | - | ≥4/76 | ≤10 | 11-15 | ≥16 |

Reference values used in this EQAS are according to CLSI (M100-S24), with the following exceptions:

* Reference values are according to CLSI M100-S24 Table 3A. These interpretative criteria are also applied for *Salmonella* and *Shigella* test strains for interpretation of AST results in this EQAS

** These breakpoints should also be applied for *Shigella* test strains for interpretation of AST results in this EQAS

*** The publication by Cavaco LM and Aarestrup FM (J. Clin. Microbiol. 2009. Sep;47(9):2751-8) provides the background for these interpretative criteria in the WHO GFN EQAS. These interpretative criteria are also applied for *Shigella* test strains for interpretation of AST results in this EQAS.

Concerning ciprofloxacin susceptibility tests, please note that for results obtained in this proficiency test, the breakpoints for *Salmonella* are applied for *Shigella* also. These breakpoints for ciprofloxacin take into consideration mechanisms of resistance due to plasmid-mediated quinolone resistance genes (e.g. *qnr*-genes) and one-point-mutation in the gyrase gene.

Important notes: *beta-lactam resistance*

The following tests for detection of Extended-Spectrum Beta-Lactamase (ESBL) production are optional.

All strains showing reduced susceptibility to cefotaxime (CTX), ceftazidime (CAZ) and/or ceftriaxone (CRO) could be tested for ESBL production by confirmatory test. Confirmatory test for ESBL production requires use of both cefotaxime (CTX) and ceftazidime (CAZ) alone, and in combination with a β -lactamase inhibitor (clavulanic acid). Synergy is defined either as i) a ≥ 3 twofold concentration decrease in an MIC for either antimicrobial agent tested in combination with clavulanic acid vs. its MIC when tested alone (E-test 3 dilution steps difference; MIC CTX : CTX/CL or CAZ : CAZ/CL ratio ≥ 8) or ii) a ≥ 5 mm increase in a zone diameter for either antimicrobial agent tested in combination with clavulanic acid vs. its zone when tested alone (CLSI M100 Table 2A; Enterobacteriaceae). The presence of synergy indicates ESBL production.

Of note, MIC values and relative interpretation of cefotaxime (CTX), ceftazidime (CAZ) and/or ceftriaxone (CRO) used for detection of beta-lactamase-producing strains in this EQAS should be reported as found.

3.4 Handling the *Campylobacter* strains

Lyophilised cultures are supplied in vacuum-sealed ampoules. Care should be taken in opening the ampoule, and all instructions given below should be followed closely to ensure the safety of the person who opens the ampoule and to prevent contamination of the culture.

- a. Check the number of the culture on the label inside the ampoule
- b. Make a file cut on the ampoule near the middle of the plug
- c. Disinfect the ampoule with alcohol-dampened gauze or alcohol-dampened cotton wool from just below the plug to the pointed end
- d. Apply a red-hot glass rod to the file cut to crack the glass and allow air to enter slowly into the ampoule
- e. Remove the pointed end of the ampoule into disinfectant
- f. Add about 0.3 ml appropriate broth to the dried suspension using a sterile Pasteur pipette and mix carefully to avoid creating aerosols. Transfer the contents to one or more suitable solid and /or liquid media

- g. Transfer the rest of the content of the ampoule to a test tube containing 5-6 ml of a suitable liquid media.
- h. Incubate the agar plate and liquid media at a temperature of 42°C at microaerobic conditions for 24-48 hours.
- i. Autoclave or disinfect effectively the used Pasteur pipette, the plug and all the remains of the original ampoule before discarding
- j. Inoculate a second agar plate from the liquid media with a 10µl loop or a cotton swab if the initial plate had inadequate growth.
- k. Select a pure culture with vigorous growth from the agar plate for further work.

Please note that:

- Cultures may need at least one subculture before they can be optimally used
- Unopened ampoules should be kept in a dark and cool place!

For reconstitution of *C. jejuni* ATCC33560 reference strain, please see the document 'Instructions for opening and reviving lyophilised cultures' on the WHO Collaborating Centre website (see www.antimicrobialresistance.dk).

3.5 Identification of *Campylobacter*

The thermophilic *Campylobacter* isolate should be identified to species level.

3.6 Antimicrobial susceptibility testing of *Campylobacter*

The *Campylobacter* test strain and the *C. jejuni* reference strain ATCC33560 should be tested for susceptibility to as many antimicrobials as possible among the ones mentioned in the test form. It should be noted that only MIC methods (i.e. broth or agar dilution methods) are recommendable for AST of *Campylobacter*. Neither the use of disk diffusion nor E-test is recommendable for AST of *Campylobacter*.

In this EQAS, the breakpoints used for interpretation of MIC results for *Campylobacter* are epidemiological cut-off values according to EUCAST (European Committee on Antimicrobial Susceptibility Testing; www.eucast.org; Table 2). Consequently, only two categories of characterisation (resistant, R or susceptible, S) are allowed. In the evaluation report that you receive upon result submission, you can find that obtained interpretations in agreement with the expected interpretation, will be categorised as 'correct', whereas deviations from the expected interpretation will be categorized as 'incorrect'.

Please report the breakpoints that you routinely use in your laboratory for interpretation of antimicrobial susceptibility test results, in the fields available in the database (or in the test form).

Note that the interpretation of antimicrobial susceptibility test results for *Campylobacter* requires knowledge of the *Campylobacter* species. If you did not sign-up for *Campylobacter* identification, but perform AST on *Campylobacter*, you are welcome to contact the EQAS Coordinator to obtain information regarding the identity of the *Campylobacter* test strain.

Table 2. Interpretive criteria for *Campylobacter* antimicrobial susceptibility testing

| Antimicrobials for <i>Campylobacter</i> | MIC (µg/mL) R is > <i>C. jejuni</i> | MIC (µg/mL) R is > <i>C. coli</i> |
|---|---|---|
| | | |
| Ciprofloxacin, CIP | 0.5 | 0.5 |
| Erythromycin, ERY | 4 | 8 |
| Gentamicin, GEN | 2 | 2 |
| Nalidixic acid, NAL | 16 | 16 |
| Streptomycin, STR | 4 | 4 |
| Tetracycline, TET | 1 | 2 |

Reference values for interpretation of *Campylobacter* AST results according to EUCAST

The sub-cultured *Campylobacter* strains should be used for MIC-testing after incubation at 36-37°C for 48 hours or at 42°C for 24 hours. Likely, two subcultures are needed prior to MIC-testing to ensure optimal growth.

3.7 Identification of the unknown environmental bacterium

The 'unknown' isolate should be identified to species level and further typed if relevant.

4 REPORTING OF RESULTS AND EVALUATION

We recommend that you write your results in the enclosed test forms and that you read carefully the description in paragraph 5 before entering your results in the web database. For entering your results via the web, you will be guided through all steps on the screen and you will immediately be able to view and print a report evaluating your results. Results in agreement with the expected interpretation are categorised as 'correct', while results deviating from the expected interpretation are categorised as 'incorrect'.

Results must be submitted no later than 31 December 2014.

**WHO Collaborating Centre
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If you do not have access to the Internet, or if you experience difficulties in entering your results, please return the completed test forms by e-mail, fax or mail to the National Food Institute, Denmark.

All results will be summarized in a report which will be publicly available. Individual results will be anonymous and will only be forwarded to the official GFN Regional Centre in your region.

We are looking forward to receiving your results.

If you have any questions or concerns, please do not hesitate to contact the EQAS Coordinator:

Susanne Karlsmose

National Food Institute, Technical University of Denmark

Kemitorvet, Building 204 ground floor, DK-2800 Lyngby - DENMARK

Tel: +45 3588 6601, Fax: +45 3588 6341

E-mail: suska@food.dtu.dk

It is possible to communicate with the EQAS organisers in other languages than English. However, this is not a direct contact with the EQAS organisers since translation of the message is required. The following languages may be used: Chinese, French, Portuguese, Russian and Spanish.

5 HOW TO ENTER RESULTS IN THE INTERACTIVE DATABASE

Please carefully read these instructions before entering the web page. Remember that you need by your side the completed test forms and the breakpoint values you used.

In general, you can browse back and forth in the pages of the database. Always remember to save your input before leaving a page.

- 1) Enter the WHO Collaborating Centre website (from <http://www.antimicrobialresistance.dk>), then
 - a. Click on 'EQAS'
 - b. Click on the link for the interactive database (<http://eqas.food.dtu.dk/who>)
 - c. Write your username and password in lower-case letters and click on 'Login'.
You can find your username and password in the letter following your strains.
Your username and password will remain unchanged in future trials. Do not hesitate to contact us if you experience problems with the login.

2) Click on 'Materials and methods'

- a. Fill in the fields relative to brand of antisera (very important because we would like to compare results obtained with different brands of antisera)
- b. Fill in the fields relative to the method used for antimicrobial susceptibility testing
- c. Enter the brand of materials, e.g. Oxoid
- d. Fill in the field asking whether your institute serves as a national reference laboratory
- e. In the comment field, report which antisera you think is required to complete your serotyping, if relevant
- f. Click on 'Save and go to next page' – ALWAYS remember to save each page before leaving it!

3) In the data entry page 'Routinely used breakpoints'

- a. Fill in the fields relative to the breakpoints used routinely in your laboratory to determine the antimicrobial susceptibility category. Remember to use the operator keys in order to show – equal to (=), less than (<), less or equal to (\leq), greater than (>) or greater than or equal to (\geq).

4) In the data entry pages '*Salmonella* strains 1-8',

- a. SELECT the serogroup (O-group) from the drop-down list, DO NOT WRITE – Wait a few seconds – the page will automatically reload, so that the drop-down list in the field "Serotype" only contains serotypes belonging to the chosen serogroup.
- b. SELECT the serotype from the drop-down list – DO NOT WRITE – wait a few seconds and you can enter the antigenic formula (e.g. 1,4,5,12:i:1,2)
- c. Enter the zone diameters in mm or MIC values in $\mu\text{g/ml}$. Remember to use the operator keys to show e.g. equal to (=), etc.
- d. Enter the interpretation as R (resistant), I (intermediate) or S (susceptible)
- e. If you performed confirmatory tests for ESBL production, select the appropriate result.
- f. If relevant, fill in the field related to comments (e.g. which antisera you miss for complete serotyping)
- g. Click on 'Save and go to next page'

If you did not perform these tests, please leave the fields empty

5) In the data entry page '*E. coli* reference strain':

- a. Enter the zone diameters in mm or MIC values in $\mu\text{g/ml}$. Remember to use the operator keys to show e.g. equal to (=), etc.
- b. Click on 'Save and go to next page'

6) In the page 'Identification of *Campylobacter* and unknown sample':

- a. Choose the correct *Campylobacter* species from the pick list

- b. Fill in the field concerning species and type of the unknown bacterial isolate, and report the method used for identification
- c. Click on 'Save and go to next page'

If you did not perform these tests, please leave the fields empty

- 7) The next page is a menu that allows you to review the input pages and approve your input *and finally see and print the evaluated results*
- a. Browse through the input pages and make corrections if necessary. Remember to click on 'save and go to next page' if you make any corrections.
 - b. Approve your input. Be sure that you have filled in all the results before approval, as **YOU CAN ONLY APPROVE ONCE!** The approval blocks your data entry into the interactive database, but allows you to see the evaluated results.
 - c. As soon as you have approved your input, an evaluation report will appear.
- 8) After browsing all pages in the report, you will find a new menu. You can choose 'EQAS 20xx start page', 'Review evaluated results' (a printer friendly version of the evaluation report is also available) or 'Go to WHO GFN homepage'.

End of entering your data – thank you very much!

SUBCULTURE AND MAINTENANCE OF QUALITY CONTROL STRAINS

1.1 Purpose

Improper storage and repeated subculturing of bacteria can produce alterations in antimicrobial susceptibility test results. The Clinical and Laboratory Standards Institute (CLSI, formerly NCCLS) has published a guideline for Quality Control (QC) stock culture maintenance to ensure consistent antimicrobial susceptibility test results.

1.2 References

M100-S21, January 2011 (Performance Standards for Antimicrobial Susceptibility Testing)

M7-A8, January 2009 (Methods for Dilution Antimicrobial Susceptibility Test for Bacteria That Grow Aerobically; Approved Standard)

1.3 Definition of Terms

Reference Culture: A reference culture is a microorganism preparation that is acquired from a culture type collection.

Reference Stock Culture: A reference stock culture is a microorganism preparation that is derived from a reference culture. Guidelines and standards outline how reference stock cultures must be processed and stored.

Working Stock Cultures: A working stock culture is growth derived from a reference stock culture. Guidelines and standards outline how working stock cultures must be processed and how often they can be subcultured.

Subcultures (Passages): A subculture is simply the transfer of established microorganism growth on media to fresh media. The subsequent growth on the fresh media constitutes a subculture or passage. Growing a reference culture or reference stock culture from its preserved status (frozen or lyophilized) is not a subculture. The preserved microorganism is not in a stage of established growth until it is thawed or hydrated and grown for the first time

1.4 Important Considerations

- Do not use disc diffusion strains for MIC determination.
- Obtain QC strains from a reliable source such as ATCC
- CLSI requires that QC be performed either on the same day or weekly (only after 30 day QC validation)
- Any changes in materials or procedure must be validated with QC before implemented
- For example: Agar and broth methods may give different QC ranges for drugs such as glycopeptides, aminoglycosides and macrolides

- Periodically perform colony counts to check the inoculum preparation procedure
- Ideally, test values should be in the middle of the acceptable range
- Graphing QC data points over time can help identify changes in data helpful for troubleshooting problems

1.5 Storage of Reference Strains

Preparation of stock cultures

- Use a suitable stabilizer such as 50% fetal calf serum in broth, 10-15% glycerol in tryptic soy broth, defibrinated sheep blood or skim milk to prepare multiple aliquots.
- Store at -20°C, -70°C or liquid nitrogen. (Alternatively, freeze dry.)
- Before using rejuvenated strains for QC, subculture to check for purity and viability.

Working cultures

- Set up on agar slants with appropriate medium, store at 4-8°C and subculture weekly.
- Replace the working strain with a stock culture at least monthly.
- If a change in the organisms inherent susceptibility occurs, obtain a fresh stock culture or a new strain from a reference culture collection e.g. ATCC.

1.6 Frequency of Testing

Weekly vs. daily testing

Weekly testing is possible if the lab can demonstrate satisfactory performance with daily testing as follows:

- Documentation showing reference strain results from 30 consecutive test days were within the acceptable range.
- For each antimicrobial/organism combination, no more than 3 out of 30 MIC values may be outside the acceptable range.

When the above are fulfilled, each quality control strain may be tested once a week and whenever any reagent component is changed.

Corrective Actions

If an MIC is outside the range in weekly testing, corrective action is required as follows:

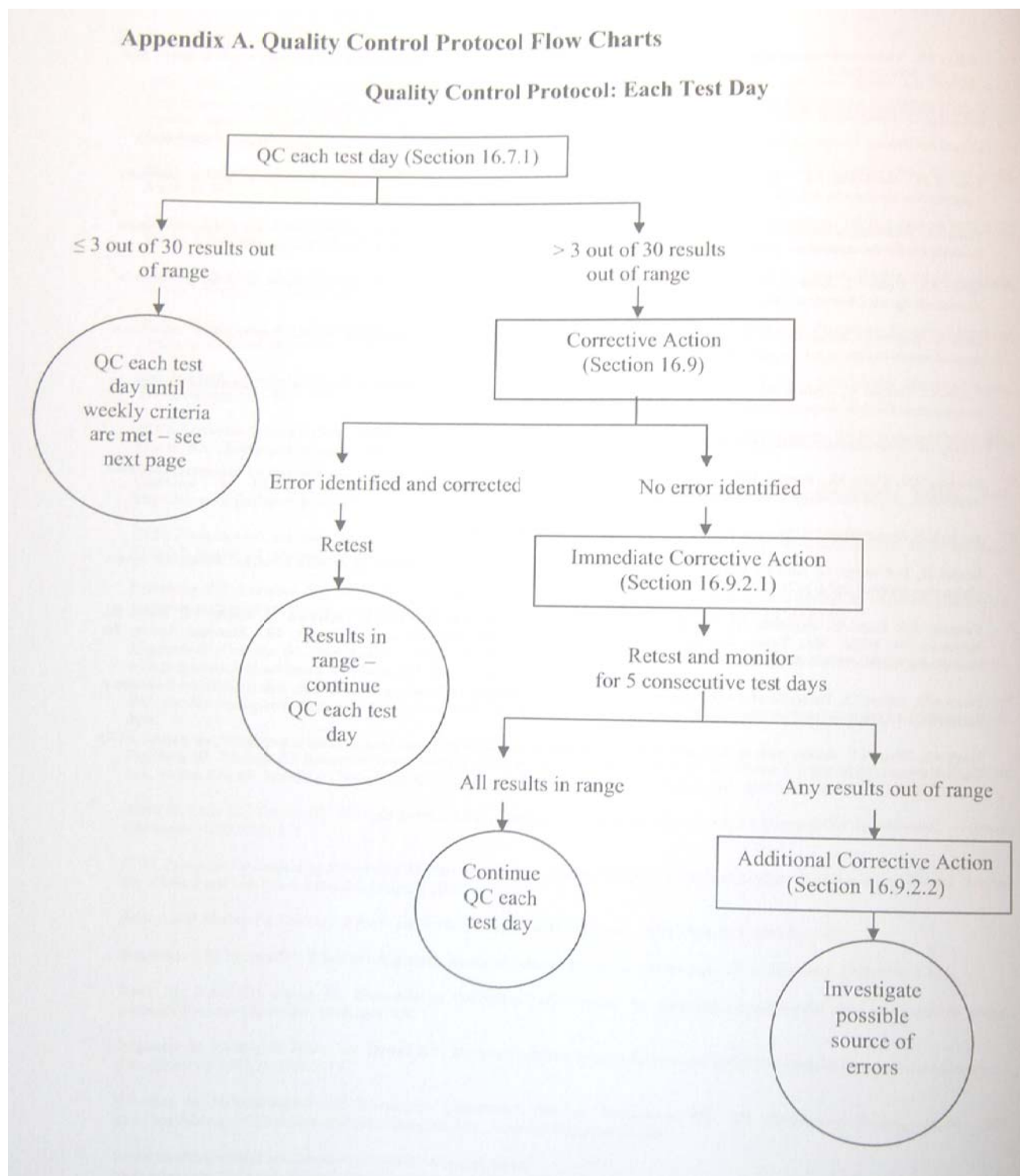
- Repeat the test if there is an obvious error e.g. wrong strain or incubation conditions used
- If there is no obvious error, return to daily control testing

The problem is considered resolved only after the reference strain is tested for 5 consecutive days and each drug/organism result is within specification on each day.

If the problem cannot be resolved, continue daily testing until the errors are identified.

Repeat the 30 days validation before resuming weekly testing.

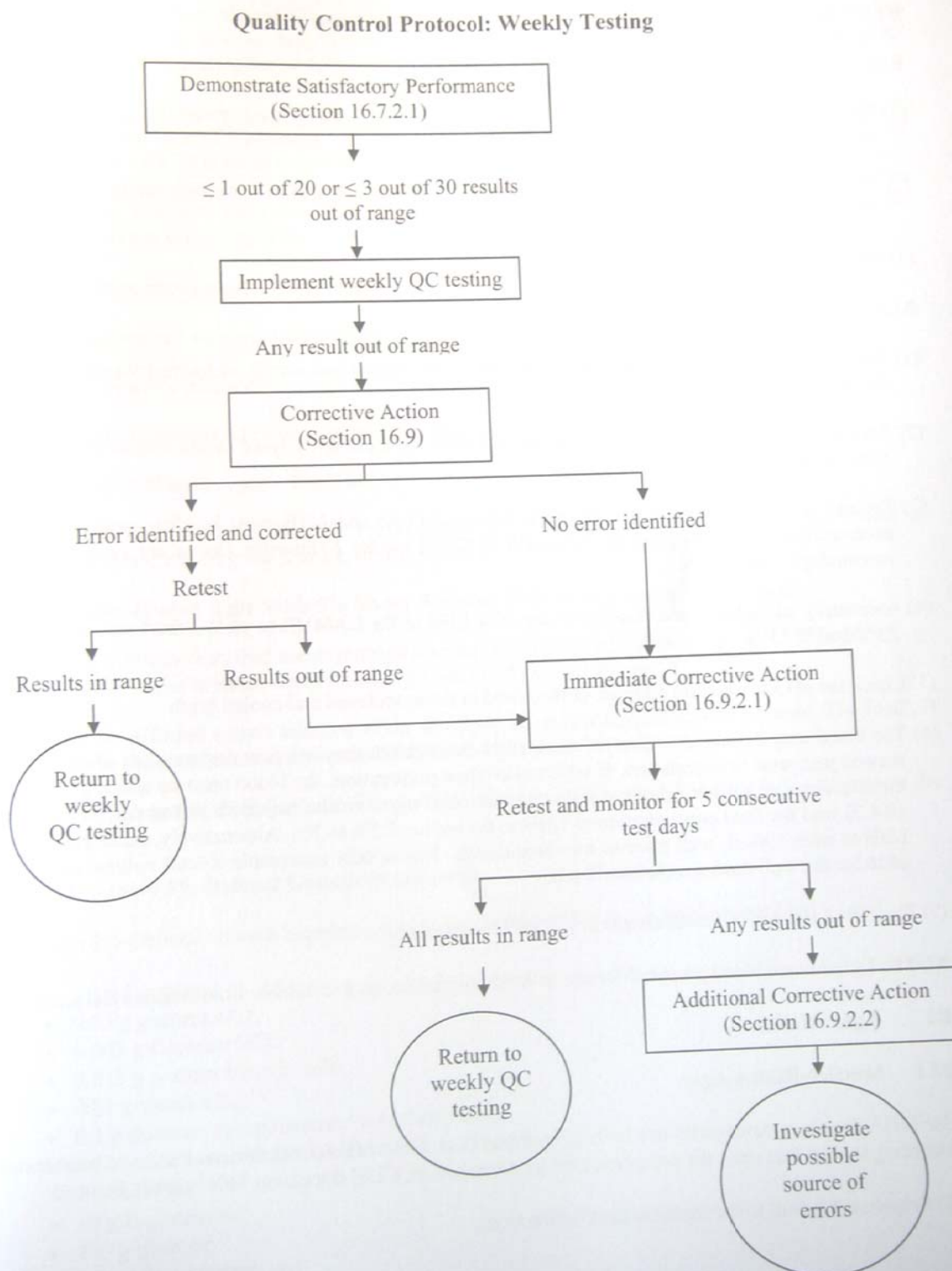
DAILY MIC QC CHART



Reference: CLSI M7-A8, page 44

WEEKLY MIC QC CHART

Appendix A. (Continued)



Reference: CLSI M7-A8, page 45

INSTRUCTIONS FOR OPENING AND REVIVING LYOPHILISED CULTURES

Manual from Czech Collection of Microorganisms (CCM)
 Masaryk University
 Tvrdého 14
 602 00 BRNO
 Czech Republic

Lyophilised cultures are supplied in vacuum-sealed ampoules. Care should be taken in opening the ampoule. All instructions given below should be followed closely to ensure the safety of the person who opens the ampoule and to prevent contamination of the culture.

- a. Check the number of the culture on the label inside the ampoule
- b. Make a file cut on the ampoule near the middle of the plug
- c. Disinfect the ampoule with alcohol-dampened gauze or alcohol-dampened cotton wool from just below the plug to the pointed end
- d. Apply a red-hot glass rod to the file cut to crack the glass and allow air to enter slowly into the ampoule
- e. Remove the pointed end of the ampoule into disinfectant
- f. Add about 0.3 ml appropriate broth to the dried suspension using a sterile Pasteur pipette and mix carefully to avoid creating aerosols. Transfer the contents to one or more suitable solid and /or liquid media
- g. Incubate the inoculated medium at appropriate conditions for several days
- h. Autoclave or disinfect effectively the used Pasteur pipette, the plug and all the remains of the original ampoule before discarding

Please note that:

- Cultures should be grown on media and under conditions as recommended in the CCM catalogue
- Cultures may need at least one subculturing before they can be optimally used in experiments
- Unopened ampoules should be kept in a dark and cool place!

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